MICRO FOCUS

Open Enterprise Server 2018 SP3

Storage Services File System Administration Guide for Linux

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About This Guide

This documentation describes how to use Storage Services File System (NSS) to manage pools, volumes, and software RAIDs on a Open Enterprise Server (OES) 2018 SP3 Server.

- Chapter 1, “Overview of NSS,” on page 25
- Chapter 2, “What’s New or Changed in NSS,” on page 33
- Chapter 3, “NSS Active Directory Support,” on page 39
- Chapter 4, “Installing and Configuring OES Storage Services,” on page 43
- Chapter 5, “Upgrading the NSS Media Format,” on page 51
- Chapter 6, “Planning NSS Storage Solutions,” on page 61
- Chapter 7, “Using NSS in a Virtualization Environment,” on page 77
- Chapter 8, “Cross-Platform Issues for NSS,” on page 85
- Chapter 9, “Cluster-Enabling Shared NSS Devices and Pools with OES Cluster Services,” on page 89
- Chapter 10, “Management Tools for NSS,” on page 93
- Chapter 11, “Managing Devices,” on page 125
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- Chapter 19, “Managing NSS Volumes,” on page 261
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- Chapter 21, “Securing Access to NSS Volumes, Directories, and Files,” on page 301
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- Chapter 28, “Tuning NSS Performance,” on page 395
- Chapter 29, “Monitoring the Status of the NSS File System and Services,” on page 405
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- Chapter 31, “Security Considerations,” on page 427
- Appendix A, “NSS Commands,” on page 439
- Appendix B, “NSS Utilities,” on page 483
- Appendix C, “Using Linux Commands to Manage NSS Devices,” on page 523
- Appendix D, “List of NSS Features,” on page 531
- Appendix E, “Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems,” on page 537
- Appendix F, “NSS Nomenclature,” on page 545

Audience

This guide is intended for network administrators. Chapter 31, “Security Considerations,” on page 427 is intended for security administrators or anyone who is using NSS storage objects and is responsible for the security of the system.

Feedback

We want to hear your comments and suggestions about this manual and the other documentation included with this product. Please use the User Comment feature at the bottom of each page of the online documentation.

Documentation Updates

The latest version of this *NSS File System Administration Guide for Linux* is available on the OES documentation website.

Additional Documentation

For information about planning and implementing storage solutions in Open Enterprise Server, see the following:

- The “Storage and File Systems” section in the *OES 2018 SP3: Planning and Implementation Guide* describes considerations for choosing a storage solution and system-wide caveats for implementing the different storage solutions.
- *OES 2015 SP1: Storage and File Services Overview* describes typical requirements for system storage, and identifies the various storage products and services in Open Enterprise Server that address those requirements.

For more information about services referenced in this guide, see the following:

- The *OES 2018 SP3: Distributed File Services Administration Guide for Linux* describes how to configure and manage DFS services for NSS volumes.
- The *OES 2018 SP3: Dynamic Storage Technology Administration Guide* describes how to configure NSS volumes as shadow volumes by using Dynamic Storage Technology.
- The *OES 2018: File Systems Management Guide* describes the OES trustee model and how to configure file system trustees, trustee rights, and attributes for NSS volumes.
- The *OES 2018 SP3: NCP Server for Linux Administration Guide* describes how to manage NCP connections for NSS volumes.

- The *OES 2018 SP3: Linux User Management Administration Guide* describes how to Linux-enable users.
- The *NDK: Virtual File Services* (https://www.microfocus.com/documentation/open-enterprise-server-developer-documentation/virtual-file-services/) describes the software APIs for creating software applications and scripts to manage NSS volumes and services on Linux and NetWare.
- The *NDK: Novell Storage Architecture Component (Media Manager and NWPA)* (https://www.microfocus.com/documentation/open-enterprise-server-developer-documentation/) describes software APIs for creating storage-related applications.
- Novell Storage Services Error Codes (http://www.novell.com/documentation/nwec/nwec/data/al3s3ui.html)
- The SLES 12: Storage Administration Guide (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html) describes storage services such as the Logical Volume Manager (LVM), UUIDs, Linux multipath I/O for devices; and Linux software RAIDs 0, 1, 5, 6, and 10.
- Logical Volume Management for Linux documentation (http://sourceware.org/lvm2/).

1 Overview of NSS

Open Enterprise Server (OES) provides Storage Services (NSS) file system for the Linux operating system. This section describes benefits and key features of NSS.

- Section 1.1, “Introduction to NSS,” on page 25
- Section 1.2, “Benefits of NSS,” on page 25
- Section 1.3, “Understanding NSS,” on page 26
- Section 1.4, “NSS Features and Capabilities,” on page 28
- Section 1.5, “Comparison of NSS to Other File Systems,” on page 30
- Section 1.6, “What’s Next,” on page 31

1.1 Introduction to NSS

The NSS file system and services provide visibility, a trustee access control model, multiple simultaneous name space support, native Unicode, user and directory quotas, rich file attributes, multiple data stream support, event file lists, and a file salvage subsystem. These capabilities can help you effectively manage your shared file storage for any size of organization, scaling from small businesses to even the largest of organizations with hundreds of thousands of employees.

NSS volumes that were created on NetWare are cross-compatible between Linux and NetWare. This allows you to use a mixed-platform cluster with OES Cluster Services while converting a cluster from NetWare to Linux. NSS volumes can fail over between Linux and NetWare, allowing for full data, trustee, and file system feature preservation when migrating data to Linux.

NSS devices and storage can be managed in the Web-based iManager utility or with server-based management tools. NSS also supports third-party tools on both platforms for advanced data protection and management, virus scanning, and traditional archive and backup solutions.

1.2 Benefits of NSS

Files are at the heart of every company, large or small. Whether your network spans continents or a few cubicles, your files become the foundation of your business. No one can afford unreliable file service, especially when the files you manage are continually growing and requiring more and more storage space.

Businesses today demand more storage space and faster and easier access to data. To meet the demands, you need a file system that can scale to a growing business, is easily maintained, and is better protected against corruption. NSS provides a variety of features that can be combined to provide a robust and reliable solution for your business.

NSS provides the following benefits:

- A journaling file system that lets you create bigger volumes that activate (mount) quicker, store more data, and resist corruption better than non-journaling file systems.

- Encrypted volume support to meet the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen.
- Access control and visibility management using the OES trustee model.
- An unlimited number of NSS volumes, with up to 255 mounted concurrently.
- Lower memory requirements: 1 MB of RAM can activate an NSS volume.
- Pools of storage that span multiple devices and support dynamic resizing to grow the pool and volumes.
- Pool snapshots that capture point-in-time versions of files in the pool.
- Software RAID support, including RAID 0 (striping), RAID 1 (mirroring), and RAID 5 (Block-level striping with distributed parity), RAID 0+1 (mirroring RAID 0 devices), and RAID 5+1 (mirroring RAID 5 devices).
- Multiple server activation prevention (MSAP) to help protect pools from being concurrently activated by multiple servers that do not share a cluster relationship.
- Up to 4 billion (10E9) files in a single directory, so how you organize files is limited only by the application or file browser, not the file system.
- Faster access to data, regardless of file size or volume size.
- Directory space restrictions.
- User space restrictions.
- Salvage support for deleted volumes and files.
- Data compression.
- Delayed block allocation helps to reduce the disk fragmentation and thereby improves the read access time. For more information, see Section 1.4.6, “Delayed Block Allocation,” on page 30.
- Distributed File Services allows you to better manage storage growth by defining virtual file structures with junctions, moving volumes, and splitting volumes. For information, see the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.

1.3 Understanding NSS

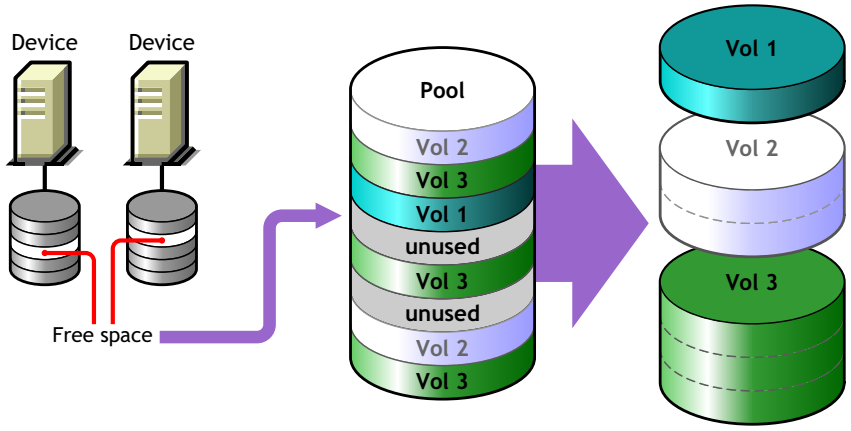
NSS is a 64-bit file system that can manage a virtually unlimited number of file objects. On each physical storage device, NSS abstracts physical partitions to make them appear as contiguous free space. With NSS you can create any number of virtual storage resources, called pools. Beginning with OES 2015, NSS supports two types of pools: NSS32 and NSS64. NSS32 pools use 32-bit block addressing and supports pool size upto 8 TB. On the other hand, NSS64 pools use 64-bit block addressing and supports pool size upto 8 EB (exabyte). All pools prior to OES 2015 use 32-bit block addressing and they are of type NSS32. A pool can contain any number of volumes. If the pool spans devices by using space from them for the pool, the volumes automatically span the devices. A single NSS32-bit volume can contain up to 8 trillion files and grow upto 8 TB in size; NSS64-bit volume can grow up to 8 EB in size. The volume sizes depend on the size of the pool and space consumed by other volumes in the pool.

- Section 1.3.1, “Storage Pools,” on page 27
- Section 1.3.2, “NSS Volumes,” on page 27

1.3.1 Storage Pools

You can use NSS pools and volumes to store applications, files, and databases. You create storage pools by assigning areas of free space obtained from one or more of a server's storage devices. You can create one or more NSS volumes from the space in the storage pool. The following figure shows how NSS uses free space on multiple devices to create a storage pool.

Figure 1-1 *NSS Pool Architecture*



1.3.2 NSS Volumes

The logical volumes you create on NSS storage pools are called NSS volumes. You can specify a maximum storage quota for the volume, or allow the volume to grow dynamically to the size of its pool. You can add any number of volumes to a storage pool.

Because there is no limit to the number of volumes you can create, it is possible that the combined administrative size of all the volumes taken together is larger than the physical size of the storage pool itself. NSS refers to this process as "overbooking." If you overbook space in the pool, the individual administrative size of a volume cannot exceed the size of the storage pool.

NSS allocates space from the pools to the volumes only as needed. Typically, user consumption of a volume's available space ebbs and flows; it is unlikely that users concurrently consume volumes at 100% of their available capacity. Each volume consumes the space it needs as it needs it. By overbooking space, NSS provides a flexible and cost effective way to accommodate expanding storage needs.

For example, suppose you have a 300 GB storage pool. From this storage pool, you create two NSS volumes of 200 GB. You can define two 200 GB NSS volumes out of a storage pool of only 300 GB, if you feel comfortable that the NSS volumes will not both exceed 75 percent capacity (150 GB) and therefore, exceed the overall size of the storage pool. If one NSS volume does reach 150 GB, but the other volume stays under 100 GB, your overbooking plan worked.

Suppose you expect one of the volumes might exceed its share of the pool. You can overbook the pool by creating one NSS volume with a quota of 200 GB and a second NSS volume that can grow to the size of the pool. As the combined size nears the size of the pool, you can extend the size of the pool by adding another segment to it, allowing more space for the larger, expanding volume. Your overbooking plan works because you built in the opportunity to expand the pool and volume, according to your business needs.

1.4 NSS Features and Capabilities

NSS helps improve the scalability, flexibility, and availability of your storage devices. This section identifies specific NSS features that help you do the following:

- Section 1.4.1, “Use Less Memory and Gain More Speed,” on page 28
- Section 1.4.2, “Improve Storage Availability,” on page 28
- Section 1.4.3, “Prevent Unauthorized Access,” on page 29
- Section 1.4.4, “Protect Data from Corruption or Loss,” on page 29
- Section 1.4.5, “Maximize Available Space,” on page 29
- Section 1.4.6, “Delayed Block Allocation,” on page 30

1.4.1 Use Less Memory and Gain More Speed

NSS requires only about 1 MB of server memory to activate a volume, independent of the number of files it contains. With NSS, you can activate up to 256 NSS volumes concurrently per server, up to the available server memory.

Whenever you activate an NSS volume, it takes only seconds to mount a volume instead of minutes. NSS uses a journaling file system and does not need to scan the entire file system to create a directory entry table (DET) to load the volume. NSS loads a file’s metadata into the memory only when you access the file.

NSS reads the file system journal only if a server goes down abnormally. Instead of slowly searching the volume for errors, NSS reads the journal to identify any incomplete transactions. It either completes the transaction or backs it out. This results in less server down time and is beneficial for applications such as mail services.

1.4.2 Improve Storage Availability

NSS provides the following features to improve I/O performance and provide fault-tolerant access to your data:

- Software RAID support for RAIDs 0, 1, 5, 0+1, and 5+1

  Uses software RAID devices to improve performance and availability. For information, see Chapter 14, “Managing NSS Software RAID Devices,” on page 183.

- Shared-disk storage

  Makes devices shareable for use in a cluster. For information, see Section 11.6, “Sharing Devices,” on page 133.

- Multiple name space support

  NSS provides full support for filenames in the Long, UNIX, DOS, and Macintosh name spaces. Long name space is the default. For information, see “Lookup Namespace” on page 265.

- Rich file metadata support

  NSS provides full support for all file attributes and multiple simultaneous data streams for DOS, Windows, UNIX, and Macintosh. For information, see Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301.

1.4.3 Prevent Unauthorized Access

NSS includes the following features to help prevent access to data that circumvents normal access control:

- Encrypted Volume Support

  Encrypts data volumes, meeting U.S. Government security standards. For information, see "Managing Encrypted NSS Volumes" on page 293.

- Data shredding (up to 7 times) for deleted files

  Erases files completely, meeting U.S. Government security standards. For information, see Section 21.3, "Using Data Shredding to Prevent Access to Purged Files," on page 312.

- Multiple Server Access Prevention for pools

  Ensures data integrity by preventing unauthorized access to shared media in a storage area network. For information, see Section 16.14, "Preventing Pools from Activating on Multiple Servers," on page 225.

- Trustee model for access control on NSS volumes

  NSS uses the OES Trustee model to greatly simplify access control management in the file system. It restricts visibility of data structures so that users only see subdirectories they have rights to see, not the whole tree like all other file systems.

  For information about the OES Trustee model and NSS file system rights, see the *OES 2018: File Systems Management Guide*.

  Some additional steps are necessary to configure access control for NSS. For information, see Section 6.5, "Access Control for NSS," on page 68.

1.4.4 Protect Data from Corruption or Loss

NSS includes the following features to ensure that the most current copy of your data is recoverable:

- Pool snapshots to provide point-in-time views of data

  Backs up files from snapshots of data so that all files, including open ones, are backed up. For information, see "Managing NSS Pool Snapshots" on page 243.

- Immediate data saves

  Writes data to the volume at regular intervals in order to reduce the seek time on the drive. For information, see Section 28.3, "Configuring or Tuning Group I/O," on page 396.

- Salvage file subsystem

  Recovers files, directories, and volumes that were deleted by applications or from the terminal/console commands. For information, see "Salvaging and Purging Deleted Volumes, Directories, and Files" on page 351.

1.4.5 Maximize Available Space

NSS includes the following features to help you maximize your available space:

- File compression

Compresses inactive files, according to preset parameters, to conserve space in a volume. For information, see "Managing Compression on NSS Volumes" on page 319.

- Volume space restrictions

  Limits the amount of space a volume can consume in its pool. For information, see Section 23.2, "Managing NSS Volume Quotas," on page 339.

- Directory space restrictions

  Limits the amount of space a subdirectory can consume, regardless of broader volume and user constraints. For information, see Section 23.3, "Managing Directory Quotas," on page 340.

- User space restrictions

  Limits the amount of space a user's data can consume, regardless of broader directory or volume constraints. For information, see Section 23.4, "Managing User Space Quotas," on page 344.

1.4.6 Delayed Block Allocation

Delayed block allocation in NSS improves the locality of sequential file content on a disk and thereby reduces the disk fragmentation.

Buffered writes is the only supported write mechanism in NSS. During buffered writes, delayed block allocation allows aggregation of sequential file blocks before writing them to the disk. The aggregation of sequential file blocks allows all the blocks to be allocated as a single extent (set of contiguous disk blocks) instead of separate disk blocks, if they were allocated at user write time. This locality of sequential file blocks on disk helps to improve the access time during the sequential read work loads such as filesystem reads or backup.

Even writes of such blocks into disks perform better as it minimizes the rotational and seek latencies involved in the movement of disk head in a rotational disk, compared to the traditional block allocation.

Delayed block allocation also reduces the writes of NSS metadata such as journal, fileMap, freeTree and logged pool or volume as it now updates each of these metadata for all aggregated sequential file blocks instead of individual user file block writes.

1.5 Comparison of NSS to Other File Systems

Use the following table to find comparisons of NSS on Linux to NSS on NetWare and to NCP volumes on Linux POSIX file systems:

Comparison	NSS on NetWare	NSS on Linux	Linux POSIX File Systems plus NCP Server
List of NSS Features (page 531)	✓	✓	
Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems (page 537)		✓	✓

1.6 What's Next

See Chapter 2, "What's New or Changed in NSS," on page 33 to learn about new and modified features in this release of NSS.

Review the following sections to help you plan your storage solution:

- For information about installing and configuring NSS on your server, see Chapter 4, "Installing and Configuring OES Storage Services," on page 43.
- For guidelines and instructions about upgrading the media format of NSS volumes to use hard links, see Chapter 5, "Upgrading the NSS Media Format," on page 51.
- For guidelines and instructions about migrating NSS volumes from to OES 11, see Chapter 12, "Migrating NSS Devices to OES 2018 SP2," on page 139.
- For guidelines about setting up NSS volumes and services on a virtual server, see Chapter 7, "Using NSS in a Virtualization Environment," on page 77.
- For management tools overviews and quick references, see Chapter 10, "Management Tools for NSS," on page 93.
- For information to help you plan storage services to use the NSS file system and services, see Chapter 6, "Planning NSS Storage Solutions," on page 61.

2 What's New or Changed in NSS

This section describes enhancements and changes in Storage Services since the initial release Open Enterprise Server (OES) 2018.

2.1 What's New or Changed in NSS (OES 2018 SP3)

NSS provides the following enhancements and changes in OES 2018 SP3:

Thin Provisioning Enhancements

Auto Discard: This feature discards the unused blocks automatically that are released by the pool. This functionality is supported on pools that reside completely on thin provisioned storage. This avoids user intervention to discard the unused blocks by executing the `fstrim` command.

The `nss`, `nsscon`, and `nlvm` utilities are updated with a new option `(No)AutoDiscard` to enable or disable the autodiscard feature for a given pool.

Device Agnostic: OES supports thin provisioning features (Fstrim, Auto Discard, and Blk_discard_on_delete) on all types of storage device drivers. The certified virtualized platforms by us are VMware, XEN, and KVM.

NSS Utilities Enhancements

The following NSS utilities are enhanced to include --dst option by default:

- rights
- attrib
- nssquota
- nsschown

For more information, see man page of the corresponding utility.

Linux Utilities Enhanced to Support DST

The Linux utilities - `mkdir`, `rmdir` and `mv` are enhanced to support DST. Any operation performed on a directory in the Primary volume is replicated on the shadow volumes for these utilities.

2.2 What's New or Changed in NSS (OES 2018 SP2)

NSS provides the following enhancements and changes in OES 2018 SP2:

Support for Thin Provisioning

The traditional storage provisioning (thick provisioning) is a type of storage allocation in which the blocks of data on a disk is allocated in advance. With thick provisioning, the large pools of storage capacity are allocated to individual services but remain unused. In thin provisioning, the blocks of data are allocated on-demand; that is, the storage is provisioned but not consumed until the data is written. When you delete the data on thin-provisioned storage, the free space is released to the storage system. This type of storage allocation helps to optimize the utilization of the available storage.

Beginning with OES 2018 SP2, OES supports thin provisioning on a storage device, which allows you to discard (or trim) blocks that are not in use by the pool. The `fstrim` command allows you to trim the unused blocks in the NSS pool. `fstrim` is supported only on thin-provisioned SCSI devices with VMware ESXi on a linear target. For more information, see Section 10.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 108 and Section 16.7, “Managing Fstrim on a Pool,” on page 221.

Also, added a new option `Blk_discard_on_delete` on in the `nlvm.conf` file to discard the blocks on a thin-provisioned storage disk when you delete a pool on that disk. For more information, see Configuring Settings for the NLVM Library in the OES 2018 SP3: NLVM Reference.

Support for AES-256 Encryption

A new media format named AES has been introduced beginning with OES 2018 SP2 to support the AES-256 encryption algorithm while creating NSS encrypted volumes. For more information on AES media and AES-256 encryption, see Section 5.3.3, “AES Media,” on page 58 and Chapter 20, “Managing Encrypted NSS Volumes,” on page 293.

OES User Rights Map (NURM) Enhancements

Added the following options or commands in NURM:

- To notify the users whether the user maps created are old, and suggest a refresh on that user map.
- To view the modified user maps based on the scheduled refresh time. Also, you can hover the cursor over the user map name to view the users added or removed from that user map.
- **map-users utility (Enhanced):** Commands are added to enable and set the time for scheduled refresh of usermaps.

For more information, see NURM (OES User Rights Map) in the OES 2018 SP3: NSS AD Administration Guide.

OES File Access Right Management (NFARM) Enhancements

NFARM for Windows and Mac provides the following enhancements and changes in OES 2018 SP2:

NFARM for Windows: Beginning with OES 2018 SP2, NFARM for Windows allows the eDirectory administrators or users with sufficient rights to manage the following:

- Trustee rights, inherited rights filter, and view effective rights.
- Owners, NSS attributes, and director quota

- User quota
- All paths that a user is a trustee of

Also, added an option in the Trustee Rights tab to list both eDirectory and Active Directory trustees in the trustee list. This allows the mapped eDirectory or AD administrators or users to manage the trustees and their explicit rights of both eDirectory and AD users.

NFARM for Mac: Before OES 2018 SP2, NFARM for Mac supported only salvage and purge operation on both eDirectory and Active Directory users. Beginning with OES 2018 SP2, NFARM for Mac allows the AD administrators or users with sufficient rights to manage the following:

- Trustee rights, inherited rights filter, and view effective rights.
- Director quota
- User quota

For more information, see NFARM (OES File Access Rights Management) in the OES 2018 SP3: NSS AD Administration Guide.

DSfW Integration with NSS AD in Same eDirectory Tree

Beginning with OES 2018 SP2, NSS AD servers can integrate with the DSfW domain in the same eDirectory tree where DSfW server acts as an authentication backend. The integration is certified in a single domain and trusted domain scenarios.

NSS Utilities Enhancements

The following NSS utilities are enhanced to be made aware of the DST volumes.

- rights
- attrib
- nssquota

For more information, see man page of the corresponding utility.

2.3 What's New or Changed in NSS (OES 2018 SP1-Update 2-Patch)

NSS 64-bit ZID Support (Enhanced): Beginning with this patch, NSS allows you to configure the ZID mode to `Zid32` or `Zid64` for local and shared volumes. It also provides an option to verify whether the volume is 64-bit ZID enabled or not.

For more information, see Section 19.19, "Setting and Viewing the ZID Mode for a Volume," on page 289.

The `nss` utility has been enhanced to provide an option to force enable the ZID64 mode at a volume level. For more information, see "nss /ForceVolumeZID64Mode=*volumename*" on page 482.

IMPORTANT: When you access the NSS volume with ZID value greater than the 32-bit limit using AFP, users might experience abnormal behavior while performing the file operations on that volume because of Apple Filing Protocol (AFP) limitation. Therefore, administrators must ensure that AFP users have access to only those NSS volumes with ZID value less than the 32-bit limit. For more information, see AFP Known Issue in the OES 2018 SP3: OES AFP for Linux Administration Guide.

2.4 What's New or Changed in NSS (OES 2018 SP1)

NSS provides the following enhancements and changes in OES 2018 SP1:

Support for 4Kn Advance Format

The traditional storage industry have been using a native 512 bytes physical sector size for hard drives. Due to the increasing demand for hard drives with larger capacities, the storage industry introduced an advanced format called 4K Native (4Kn) that uses 4096 bytes physical sectors.

Beginning with OES 2018 SP1, OES supports the advanced format (4Kn) that uses 4096 bytes physical sectors. However, OES also supports the emulation of 512 byte sector size to support the legacy 512 byte sectors. 512 emulation (512e) is the advanced format in which the physical sector size is 4,096 bytes, but the logical sector size emulates 512 bytes sector size.

OES User Rights Map (URM) UI Enhancements

Beginning with OES 2018 SP1, the **VIEW RIGHTS** page of OES URM is enhanced to provide a paired view of rights for both eDirectory and Active Directory trustees. Also, the user interface is refreshed to provide a new and modern look.

2.5 What's New or Changed in NSS (OES 2018-Update 1-Patch)

Access Control Right: Prior to OES 2018 (Update 1) patch, users with Access Control right were allowed to grant all rights on a given directory and below that directory. Beginning with this patch, a few changes are made on NSS and NCP server so that the trustees with Access Control right are not allowed to add or remove the Supervisor right.

2.6 What's New or Changed in NSS (OES 2018)

NSS provides the following enhancements and changes in OES 2018:

- **Salvage and Purge Support for Mac:** The traditional Salvage and Purge operation can be done natively on Mac using NFARM (OES File Access Rights Management). For example, using NFARM installer for Mac, you can recover or permanently delete the files or folders that are already deleted.
- **NSS 64-bit ZID Support:** NSS supports 64-bit IDs, which supports up to 8 trillion (8E12) ZIDs.

  NCP, CIFS, and FTP supports the NSS 64-bit ZID, which allows NSS to store up to 8 trillion files in a single volume. For more information, see ReZIDing Volumes in an NSS Pool in the OES 2018 SP3: NSS File System Administration Guide for Linux.

IMPORTANT: When the NSS volume is mapped through AFP, the NSS files and folders with ZIDs greater than 32-bit are not listed because of Apple Filing Protocol (AFP) limitation. If the NSS volume is shared over AFP, we recommend not to enable the 64-bit ZID option.

- **nss (Enhanced):** Beginning with OES 2018, the `nss` utility has been enhanced to support all the commands that `nsscon` utility supports.

  For more information, see nsscon in the OES 2018 SP3: NSS File System Administration Guide for Linux.

- **nsscon (Enhanced):** Commands are added for the following:
  - To update the SEV interval for eDirectory or AD.
  - To force the SEV update for eDirectory or AD users. Also, provided options to force the SEV update for a single eDirectory or AD user.

  For more information, see Security Equivalence Vector Update Commands in the OES 2018 SP3: NSS File System Administration Guide for Linux.

- To support the creation of pools, the following NSS tools have been enhanced:
  - **nssmu:** Beginning with OES 2018, the `nssmu` utility allows you to create only NSS64 pool type.

    For more information, see NSS Management Utility (NSSMU) Quick Reference in the OES 2018 SP3: NSS File System Administration Guide for Linux.
  - **iManager:** The iManager storage plug-ins allows you to create only NSS64 pool type.

    For more information, see Creating a Pool in the OES 2018 SP3: NSS File System Administration Guide for Linux.
  - **NLVM:** Beginning with OES 2018, if you do not specify a type while creating a pool, NLVM defaults to NSS64 pool type. You can also create NSS32 pool type by providing the option NSS32.

    For more information, see Create Pool in the OES 2018 SP3: NLVM Reference.

- **Delayed Block Allocation:** This feature is now additionally available on volumes that are enabled with Compression and Quotas.

3 NSS Active Directory Support

The information provided in this section describes about the new features or modification to the existing features to support AD users access the NSS file system natively.

- Section 3.1, “New Additions or Modifications to the Existing NSS Utilities,” on page 39
- Section 3.2, “OES File Access Rights Management (NFARM),” on page 41
- Section 3.3, “OES User Rights Map (NURM),” on page 41

3.1 New Additions or Modifications to the Existing NSS Utilities

This section lists the modification or additions done to the existing NSS utilities to support AD users.

NOTE: iManager cannot be used to manage AD users.

NSS Utility	Description
nsscon	◆ New commands have been added to upgrade the existing NSS32 media to support AD users or to enable all future NSS32 pool creation to automatically be created with the AD user support. All NSS32 pools must be AD media upgraded in order to support AD users. For more information, see Section A.13.1, “NSS Media Upgrade Commands,” on page 452. ◆ New commands have been added to AD-enable the volumes. Only after AD-enabling, the AD users will be able to access the NSS resources based on the access rights assignment. For more information, see “Volume AD-enabling” on page 454. ◆ A new PoolMediaVersion option has been added to displays the latest media version of all the active pools. For more information, see Section A.35, “Status Commands,” on page 476. ◆ /PurgesObjectLimit=: Limits the number concurrent purges. The values can be anywhere from 1 to 100000. The default value is 2000. ◆ /OverrideType=: Media upgrading a shared NSS32-bit pool in a mixed cluster node environment is not recommended. You can still force the upgrade using the /ForceADMedia switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015. As a workaround, you could create Preferred Nodes in a cluster to load the media upgraded shared NSS32-bit pools. ◆ /(No)FastWriteOfMessyBeasts: Enables or disables the fast update of messy files. By default, it is set to off. ◆ Hard Link Media Upgrade Commands: All volumes created or migrated to OES 2015 or later are automatically hard link media upgraded. Therefore, beginning with OES 2015, the hard link media upgrade commands have been removed. ◆ New commands are added to update the SEV interval for AD users. Also, provided options to force update the SEV interval for AD users and for a single AD user. For more information, see Section A.33, “Security Equivalence Vector Update Commands,” on page 473.
rights	◆ -a or --activedirectory option has been added to manage the right of Active Directory users and groups. For more information on these options, see Section B.10, “rights,” on page 504.
nsschown	The following options have been added to nsschown: ◆ **-S <oldSID>:** To list or replace all files and folders with a specified owner's SID. ◆ **-U <oldADUserName>:** To list or replace all files and folders with specified active directory owner. It can be DN or root. ◆ **-N <newADUserName>:** To change the ownership of all the files and folders with the new active directory user. It can be DN or root. ◆ **-e:** To list or replace the owner of all extended attributes and data streams. ◆ **-v:** To display the program version information. For more information, see Section B.16, “nsschown,” on page 515.

NSS Utility	Description

nssmu	The following options have been added to nssmu:
	• **Pools Page**
	  • **-j:** The join option has been added to join cluster pools to an AD domain.
	  • **-g:** This option upgrades the file system media format of the selected NSS32 pool to support AD users.
	  AD Media upgrading an NSS32-bit pool in a mixed cluster node environment is not recommended as they will not be accessible from nodes older than OES 2015. You can still go ahead and force the media upgrade by acknowledging the warning message by pressing 'y' (yes).
	• **Volumes Page**
	  • **-g:** This option AD-enables the selected volume.
	• **New shortcut options:** To enhance the user experience of NSSMU in popular SSH clients, like PuTTY, new shortcut options have been added to invoke various NSSMU functionalities.
	  For more information, see Section 10.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 108.

nssquota	-a or --activedirectory option has been added to the nssquota utility for managing the AD users quota. For more information, see Section B.13, “nssquota,” on page 511.

3.2 OES File Access Rights Management (NFARM)

OES File Access Rights Management (NFARM) is a shell (Windows) or finder (Mac) extension that enables eDirectory or Active Directory users on Windows and Mac workstation to perform Salvage and Purge operations. In addition,

- On Windows workstation, enables Windows Active Directory or eDirectory administrators or users to manage the access rights and quotas of AD or eDirectory users or groups on Storage Services (NSS) resources.
- On Mac workstation, enables Windows Active Directory administrators or users to manage the access rights and quotas of AD users or groups on Storage Services (NSS) resources.

For more information on OES File Access Rights Management, see NFARM (OES File Access Rights Management) in the OES 2018 SP3: NSS AD Administration Guide.

3.3 OES User Rights Map (NURM)

The OES User Rights Map utility is used by administrators to map the Access Control List (ACL) of the storage unit that is owned by Identity on OES to Identity on Active Directory. This utility can be used after the user identity is created on both the source and target identity stores. It maps the users from eDirectory to Active Directory using a common name or any other field that is selectable by the tool. For more information on OES User Rights Map, see NURM (OES User Rights Map) in the OES 2018 SP3: NSS AD Administration Guide.

4 Installing and Configuring OES Storage Services

This section describes how to install and configure Storage Services on Open Enterprise Server.

- Section 4.1, “Requirements for Installing NSS,” on page 43
- Section 4.2, “Installing and Configuring NSS,” on page 44
- Section 4.3, “Upgrading the Media Format for Hard Link Support,” on page 47
- Section 4.4, “Enabling Users for Linux Utilities and Services,” on page 47
- Section 4.5, “Updating NSS on OES 2018 SP2,” on page 47
- Section 4.6, “Upgrading from OES 2 to OES 2018 SP2,” on page 48

4.1 Requirements for Installing NSS

Make sure your system and storage solution meets the requirements in this section.

- Section 4.1.1, “Device Requirements,” on page 43
- Section 4.1.2, “Requirements for NSS,” on page 43
- Section 4.1.3, “Requirements for Storage-Related iManager Plug-Ins,” on page 44

4.1.1 Device Requirements

The following requirements apply to devices for NSS on the latest release of OES:

- ❒ NSS can utilize device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size) with a maximum pool size of 8 TB for NSS32 pool and 8 EB for NSS64 pool. For information, see Section 11.1.1, “Device Size,” on page 125.
- ❒ At least 12 MB of free space is needed on the storage media for each NSS pool you plan to create.
- ❒ At least 12 MB of free space is needed on the storage media for each software RAID segment you plan to create.
- ❒ For information about devices to use in a virtual environment, see Chapter 7, “Using NSS in a Virtualization Environment,” on page 77.

4.1.2 Requirements for NSS

General Requirements

The following general requirements apply to NSS:

- ❒ A physical server or virtual server running OES.

- ❒ NSS is not installed by default. You can select it during the YaST install, or install it at any time from the **YaST > Open Enterprise Server > OES Install and Configuration**.

  For information about install options, see Section 4.2, “Installing and Configuring NSS,” on page 44.
- ❒ The NSS file system is used only for data volumes on OES. The Linux operating system requires a Linux POSIX file system for its system volume, such as Ext3.
- ❒ After installing OES, install only approved updates. Refer to the *OES 2018 SP3: Installation Guide* to install the approved updates.
- ❒ A NetIQ eDirectory Read/Write replica must be available in the same tree as the server when you create an NSS pool or volume so that the Storage objects can be created in eDirectory; otherwise, NCP cannot map to the pool or volume.

4.1.3 Requirements for Storage-Related iManager Plug-Ins

For information about installing and using the storage-related iManager plug-ins, see Section 10.1, “iManager and Storage-Related Plug-Ins,” on page 93.

4.2 Installing and Configuring NSS

This section describes only those steps in the install that are directly related to installing Storage Services and its dependencies. For information about installing OES services, see the *OES 2018 SP3: Installation Guide*.

- Section 4.2.1, “Selecting the NSS Pattern During Install,” on page 44
- Section 4.2.2, “Installing NSS on an Existing OES Server,” on page 46
- Section 4.2.3, “Enabling or Disabling NSS,” on page 46

4.2.1 Selecting the NSS Pattern During Install

1. In the YaST install, on the **Installations Settings** page, click **Software** to go to the **Software Selections and System Tasks** page.

   For information about the entire install process, see the *OES 2018 SP3: Installation Guide*.
2. From the OES Services options, select **OES Storage Services**. Selecting NSS as part of a 64-bit installation automatically installs NSS 64-bit support.

   The following additional services are automatically selected:

   - OES Backup / Storage Management Services

     SMS makes it possible to back up trustee and other extended attributes for data on NSS volumes. It is also used by OES Distributed File Services for moving or splitting NSS volumes.
   - NetIQ eDirectory

     eDirectory supports authentication of users who connect to NSS volumes.
   - OES Linux User Management

LUM allows eDirectory users to be enabled for Linux services, such as access via FTP and so on. The administrator user for the server is automatically Linux-enabled with LUM. Users must be Linux-enabled with LUM in order to access data on NSS volumes with Linux services or utilities such as SSH. The Linux services must also be LUM enabled. LUM is not required for NCP, AFP, and CIFS access.

IMPORTANT: LUM is required even if the administrator user is the only LUM user on the server.

- NCP Server / Dynamic Storage Technology

  NCP Server provides support to NSS for access control, shadow volumes, commands, and file access. It is required even if you are not using NCP clients to connect to the NSS volume.

- OES Remote Manager (NRM)

  OES Remote Manager (NRM) is a browser-based management utility for monitoring server health, changing the configuration of your server, or performing diagnostic and debugging tasks.

  NRM provides the NCP Server management plug-in that allows you to create shadow volumes using NSS volumes. You can also use it to manage NCP connections to the NSS volumes.

3 Optionally select **NetIQ iManager** to be installed on the server.

  You must install iManager somewhere in the same tree as the server. If you install iManager and NSS on the same server, the storage-related plug-ins are automatically installed.

  If you install iManager on a different server, make sure you install the storage-related plug-ins that you need to manage NSS file system and services. For information about installing storage-related plug-ins on an existing server, see Section 10.1, “iManager and Storage-Related Plug-Ins,” on page 93.

4 Optionally select non-NCP file access services to be installed on the server.

  NSS requires NCP Server to be installed and running on the server even if you select one or more of these alternate methods for user access.

  - **OES AFP:** Allows Macintosh users to connect to NSS volumes with the AFP (Apple Filing Protocol). For information about configuring and managing AFP, see the *OES 2018 SP3: OES AFP for Linux Administration Guide*.
  - **OES CIFS:** Allows CIFS users to connect to NSS volumes with the CIFS protocol. For information about configuring and managing CIFS, see the *OES 2018 SP3: OES CIFS for Linux Administration Guide*.

5 Optionally select OES Cluster Services to be installed on the server.

  Install NCS if you plan to share NSS pools in a cluster. For information about installing NCS and configuring shared devices and pools using NCS, see the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

6 Click **Accept** to return to the **Installation Settings** page.

  Licensing dialog boxes might open where you are prompted to accept proprietary modules being installed.

7 Novell Identity Translator (NIT) has been introduced in OES. If you would like to change the default NIT range, on the **Micro Focus Open Enterprise Server Configuration** screen, click **OES Storage Services (NSS)** and modify the range. For more information on NIT, see "About Novell Identity Translator (NIT)" in the *OES 2018 SP3: Installation Guide*.

8 Continue with the installation.

9 After the install, use the Software Updater (or other update methods) to install any NSS patches from the OES patch channel.

4.2.2 Installing NSS on an Existing OES Server

If you did not install OES Storage Services during the OES installation, you can install it later by using **YaST > Open Enterprise Server > OES Install and Configuration**.

1 Log in to the server as the `root` user.

2 In YaST, select **Open Enterprise Server > OES Install and Configuration**.

3 In the Selection window under **OES Services**, click **OES Storage Services** and any other OES components that you want to install.

Follow the instruction for selecting NSS and its dependencies described in Section 4.2.1, "Selecting the NSS Pattern During Install," on page 44.

4 Click **Accept** to begin the install, then click **Continue** to accept changed packages.

5 Follow the on-screen instructions to complete the install.

6 After the install, enter `rcnovell-smdrd restart` at the command prompt, or reboot the server before performing any backups, restores, or server consolidations on the NSS file system.

7 Use the Software Updater (or other update methods) to install patches from the OES patch channel.

4.2.3 Enabling or Disabling NSS

When you install NSS during the initial install, NSS and its dependencies are automatically enabled in the Linux System Services (Runlevel) with Runlevels 2, 3, and 5. NSS is not automatically enabled if you post-install NSS on the server.

Although, you can uninstall OES service RPMs through YaST, we do not recommend it because so many modules have interdependencies. Uninstalling services can leave the server in an undesirable state. If you no longer plan to use a server, we recommend disabling the service.

WARNING: NSS must be enabled to use any components or tools for the NSS file system.

To enable or disable NSS:

1 Log in to the server as the `root` user, then start YaST.

2 Click **System > Services Manager**.

3 Select novell-nss, then click **Enable/Disable** to enable or disable the service.

4 Click **Ok** to save and apply your changes, then exit the YaST service manager.

4.3 Upgrading the Media Format for Hard Link Support

The pools created with OES 11 SP2 or earlier versions (without hard link media) are automatically upgraded to hard link media, when pools are loaded in OES 2015 or later server. However, new pools created are hard link media enabled by default. For guidelines and media upgrade instructions, see Chapter 5, “Upgrading the NSS Media Format,” on page 51.

4.4 Enabling Users for Linux Utilities and Services

eDirectory users must also have a Linux identity in order to access NSS volumes via Linux services and utilities such as SSH and FTP. Linux User Management (LUM) technology that creates the local Linux user identity and stores the UID for the user in eDirectory. The Administrator user for the server is automatically Linux-enabled with LUM and added to a LUM administrator group for the server as part of the installation process. Before users of the NSS volumes can access NSS volumes with Linux services and utilities, you must enable both the service and the users with LUM.

For information, about how to enable users and Linux services with LUM, see the *OES 2018 SP3: Linux User Management Administration Guide*. For more information about why LUM is necessary for Linux services and utilities, see Section 6.5, “Access Control for NSS,” on page 68.

4.5 Updating NSS on OES 2018 SP2

You can get NSS patches in the OES update channel or from the Micro Focus Download Web site (http://download.novell.com).

Consider the following issues when updating NSS:

- Section 4.5.1, “Parameter Settings,” on page 47
- Section 4.5.2, “Reboot Server or Restart jstcpd, adminusd, and volmnd,” on page 47
- Section 4.5.3, “Storage-Related Plug-Ins,” on page 48

4.5.1 Parameter Settings

When you update an OES server with a Support Pack or apply NSS patches, all NSS-related parameter settings remain the same as they were before the update or patch. For example, server-level, pool, and volume settings are not modified.

4.5.2 Reboot Server or Restart jstcpd, adminusd, and volmnd

If you do not reboot the server as part of the update or patch process, some NSS functions and tools might not work properly until you restart the `jstcpd`, `adminusd`, and `volmnd` daemons.

For example, NSSMU or the Distributed File Services (DFS) volume location database might hang when you create a volume. DFS is delivered and updated as a part of the NSS package on OES servers. If the server is a VLDB replica site, the vldb might not work properly or cause hangs when creating new NSS volumes. For information, see “DFS may not function properly after upgrading NSS on OES 2 and later.” in the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.

To ensure that NSS and DFS is functioning properly after updating OES to a support pack or applying NSS patches:

1. Log in as the `root` user, then open a terminal console.
2. At the terminal console prompt, restart the following daemons in the order indicated:

   ```
   /opt/novell/nss/sbin/jstcpd
   /opt/novell/nss/sbin/adminusd
   /opt/novell/nss/sbin/volmnd
   ```

3. If the server is a VLDB replica site for a Distributed File Services management context, restart the VLDB by entering,

   ```
   vldb stop service
   ```

   ```
   vldb start service
   ```

4.5.3 Storage-Related Plug-Ins

The File Protocols plug-in for the Native File Access Protocols for NetWare service has been replaced in OES 2 SP1 by two plug-ins: OES AFP (`afpmgmt.npm`) and OES CIFS (`cifsmgmt.npm`). These plug-ins support AFP and CIFS services for NSS volumes on both Linux and NetWare.

The AFP and CIFS plug-ins also require the NSS Management (`nssmgmt.npm`) and Storage Management (`storagemgmt.npm`) plug-ins. Other storage-related plug-ins include Archive Versioning (`arkmgmt.npm`), Cluster Services (`ncsmgmt.npm`), Files and Folders Management (`fileman.npm`), Samba Management (`sambamgmt.npm`), and Distributed File Services (`dfsmgmt.npm`). All storage-related plug-ins share code in common with the Storage Management plug-in.

You must uninstall the existing storage-related plug-ins, then install the new plug-ins at the same time to make sure that the common code works for all plug-ins.

4.6 Upgrading from OES 2 to OES 2018 SP2

Consider the following issues when upgrading from OES 2 to OES 2018 SP2:

- Section 4.6.1, “Parameter Settings,” on page 48
- Section 4.6.2, “Read Ahead Blocks Setting,” on page 49

4.6.1 Parameter Settings

When you upgrade the server, all NSS-related parameter settings remain the same as they were before the upgrade. For example, server-level, pool, and volume settings are not modified. All future pools and volumes are created with the default settings.

4.6.2 Read Ahead Blocks Setting

The Read Ahead Blocks parameter specifies the number of data blocks that NSS reads ahead for any open file on which read operations are ongoing in the specified server. Its default setting is 16. After upgrading to OES, if you experience read performance problems with an NSS volume, check the volume's Read Ahead Blocks parameter setting.

You can view or modify the Read Ahead Blocks value by using NSSMU as follows:

1. In NSSMU, select **Volumes** to view a list of volumes.
2. Select the volume, then press **Enter** to view its **Volume Properties** list.
3. Press the arrow keys to go to the **Read Ahead Count in Blocks** parameter, then press **Enter** to access the setting.
4. Type the new count value, then press **Enter**.

   Valid values are 0 to 1024 blocks, where a block is 4 KB. However, a count of 128 is the practical maximum value. Read-ahead block counts higher than 128 can starve other system components for memory or buffers, which can impair performance or cause the system to hang. As the number of concurrent connections to unique files increase, you should reduce the number of read-ahead blocks.
5. Press the arrow keys to go to **Apply**, then press **Enter** to save and apply the new setting.

You can also modify the value by using the Read Ahead Blocks switches in the NSS Console. For information, see Section A.31, "Read Ahead Blocks and Allocate Ahead Blocks Commands," on page 470.

5 Upgrading the NSS Media Format

An enhanced Storage Services (NSS) media format is available that provides native NSS resource access to Active Directory users and improved support for hard links. After you install or upgrade your operating system to Open Enterprise Server 2018 SP2, you can decide whether to upgrade the media format for your NSS volumes to use the new metadata structure; some restrictions apply.

- Section 5.1, “Guidelines for Upgrading the Media Format of NSS Volumes,” on page 51
- Section 5.2, “Enabling Hard Links After the Media Upgrade,” on page 53
- Section 5.3, “NSS Media Upgrade,” on page 54
- Section 5.4, “Automatic Pool Media Upgrade,” on page 58

5.1 Guidelines for Upgrading the Media Format of NSS Volumes

Before upgrading the media format of your NSS volumes, make sure you understand the following guidelines:

- Section 5.1.1, “Cross-Platform Support for the NSS Media Upgrade,” on page 51
- Section 5.1.2, “Which NSS Volumes to Upgrade,” on page 52
- Section 5.1.3, “Before Upgrading the Media Format,” on page 52
- Section 5.1.4, “After Upgrading the Media Format,” on page 53
- Section 5.1.5, “If You Do Not Upgrade the Media Format,” on page 53

5.1.1 Cross-Platform Support for the NSS Media Upgrade

The NSS media upgrade for enhanced hard links support is available for the following operating platforms (and later versions):

- Novell Open Enterprise Server 11
- Novell Open Enterprise Server 2 Linux and NetWare
- Novell Open Enterprise Server 1 SP2 NetWare
- NetWare 6.5 SP4

If the NSS volume is used in a cluster with OES Cluster Services, all nodes in the cluster must be upgraded to a supported platform before you upgrade the media format for any shared volumes. After you upgrade the media format on an NSS volume, it cannot be mounted on an unsupported platform.

5.1.2 Which NSS Volumes to Upgrade

With a few exceptions as noted below, it is highly recommended that you upgrade the NSS volume to the new metadata structure after you upgrade the operating system to a supported platform.

Do not upgrade the media format of the NSS volume to the new metadata structure if any of the following conditions exist:

- You have not yet verified that your system is performing as expected after upgrading the operating system, and you might need to roll back to an earlier release.
- You plan to migrate one or more devices containing the NSS volume to an unsupported platform.
- You need to share this volume with a mixed cluster with OES Cluster Services where there are some unsupported platforms in the mix. The cluster software prevents the media upgrade unless all operating systems in the cluster support the new media format.

5.1.3 Before Upgrading the Media Format

- "Opportunity to Roll Back Before the Media Upgrade" on page 52
- "Hard Link Behavior without a Media Upgrade" on page 52
- "Clusters and the Media Upgrade" on page 52

Opportunity to Roll Back Before the Media Upgrade

When you upgrade the operating system, NSS does not automatically upgrade the media format to use the new metadata structure. This allows you to the opportunity to roll back to the previous release if necessary. Before you upgrade the media format of NSS volumes to the new data structure, make sure the server is performing as expected.

WARNING: After the media format is upgraded to the new metadata structure, you cannot roll back to a previous release.

Hard Link Behavior without a Media Upgrade

Until you upgrade the media format for enhanced hard link support, any existing hard links on the NSS volume are visible, and they can be opened, closed, read, and written. However, you cannot create new hard links, and you cannot rename or delete existing hard links. Attempts to do so are rejected with an error.

Clusters and the Media Upgrade

If you attempt to upgrade the media format for a shared NSS volume on a cluster with OES Cluster Services, the upgrade is refused until all servers on the system are configured with a supported operating system. Make sure to upgrade all cluster nodes to a supported platform before attempting to upgrade the shared volume.

5.1.4 After Upgrading the Media Format

After you upgrade the volume to use the media format with enhanced hard links, the following constraints apply for its use:

- The Hard Links attribute must be enabled for the upgraded NSS volume before you can create hard links.

  When you upgrade the NSS volume to use the new media format, if any old-style hard links are detected, the Hard Links attribute is automatically enabled. Otherwise, the volume is upgraded, but the attribute is disabled and must be enabled before you can create hard links. For information, see Section 25.3, “Enabling or Disabling the Hard Links Attribute,” on page 368.
- The upgraded NSS volume cannot be rolled back to use the old media format.
- You cannot roll back the operating system to a previous version.
- You cannot migrate a device containing the upgraded volume to a system with an unsupported operating system.
- Only nodes that have a supported operating system can be added to a cluster where shared volumes use the upgraded media format.

5.1.5 If You Do Not Upgrade the Media Format

If you do not upgrade the media format for an NSS volume, the volume’s format uses the same metadata structure as is used on earlier releases. Any existing hard links on your system’s NSS volumes are visible, and they can be opened, closed, read, and written. However, until you upgrade the NSS volume to the new structure, you cannot create new hard links, and you cannot rename or delete existing hard links. Attempts to do so are rejected with an error.

If the non-upgraded NSS volume is shared in a mixed cluster with OES Cluster Services, hard links can be created, renamed, or deleted by first mounting the volume on a node in the cluster with an operating system that is compatible with the old media format.

It is possible to move devices that contain non-upgraded NSS volumes cross-platform to servers with operating systems compatible with the old media format. For information about moving media cross-platform, see Section 12.2, “Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2018 SP2,” on page 140.

5.2 Enabling Hard Links After the Media Upgrade

When NSS32-bit pools are moved to OES 2015 or later, the pools and their volumes are automatically media upgraded to support hard links. All new pools are by default media upgraded to support hard links.

After the media is upgraded successfully, you must set the Hard Links attribute on volumes where you want to create hard links. The Hard Links attribute is automatically enabled if there are existing hard links on the volume. For information about using hard links on NSS volumes, see Chapter 25, “Managing Hard Links,” on page 363.

IMPORTANT: Do not attempt to enable the Hard Links attribute until the upgrade process is complete.

1 Issue the following commands at the NSS Console (`nsscon`) as the `root` user.

Command	Description
`nss /HardLinks=`*`volumename`*	Enables the Hard Links attribute for a specified volume. This enables hard links to be created on the volume.
`nss /HardLinks=all`	Enables the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

2 You can verify that the hard links attribute is set for the volume by entering the following command at the NSS Console (nsscon):

`volumes`

The Hard Links attribute appears in the Attributes column for volumes where it is enabled.

```
blr8 > /volumes
      Volume Name           State                Attributes
-----------------------  -----------  -------------------------
_ADMIN                   ACTIVE       Hardlinks
                                      AD Enabled
ADVOL1                   ACTIVE       Salvage
                                      Hardlinks
```

5.3 NSS Media Upgrade

This section provides the commands to upgrade the NSS pools to AD or Trustee Index media.

5.3.1 AD Media

All NSS32 pools must be AD media upgraded in order to support AD users. NSS64 pools are by default Trustee Index media (includes AD media) upgraded. Use the nsscon commands in this section to upgrade the existing NSS32 media to support AD users or to enable all future NSS32 pool creation to be automatically created with the AD user support.

For the Existing NSS Pools

nss /PoolMediaUpgrade=poolname /MediaType=AD

Upgrades the specified NSS pool to support AD media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015.

The following commands can also be used to upgrade the existing NSS32 pool media to support AD users.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=poolname

Upgrades the file system media format of a particular NSS32 pool to support AD users.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all /include=shared

Any NSS32 shared pools created after running this command will be AD media enabled.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all /include=local

Any NSS32 local pools created after running this command will be AD media enabled.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all

Any NSS32 pools (shared or local) created after running this command will be AD media enabled.

NOTE: Media upgrading a shared NSS32 pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceADMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015. For more information, see "Behavior of an NSS Pool Resource with Media Version 44.03 and Above in Mixed Node Cluster" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

For the Newly Created NSS Pools

The commands placed in the `nssstart.cfg` file persists across server reboots. If the NSS commands are added in the `nssstart.cfg` file, ensure those commands are not prefixed with nss.

If these commands are issued from the command line, it persists only till a server reboot.

nss /NewPoolMediaFormat=AD /include=all

Sets the file system media format of all the newly created pools (shared or local) to support AD media.

nss /NewPoolMediaFormat=AD /include=shared

Sets the file system media format of all the newly created shared pools to support AD media.

nss /NewPoolMediaFormat=AD /include=local

Sets the file system media format of all the newly created local pools to support AD media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015.

The following commands can also be used to enable all future NSS32 pool creation to be automatically created with the AD user support.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all

Upgrades the file system media format of all the newly created NSS32 pools (shared or local) to support AD users.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all /include=shared

Upgrades the file system media format of all the newly created NSS32 shared pools to support AD users.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all /include=local

Upgrades the file system media format of all the newly created NSS32 local pools to support AD users.

NOTE: Media upgrading a shared NSS32 pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceADMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015. For more information, see "Behavior of an NSS Pool Resource with Media Version 44.03 and Above in Mixed Node Cluster" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

Media upgrading an NSS32 pool can also be done using NSSMU (Section 10.2, "NSS Management Utility (NSSMU) Quick Reference," on page 108) and iManager (Section 16.2, "Creating a Pool," on page 212).

Volume AD-enabling

Use the following commands to AD-enable the volumes. Only after AD-enabling, the AD users will be able to access the NSS resources based on the access rights assignment. Before running these commands, ensure that the pools on which these volumes exist are NSS AD media-upgraded.

nss /ADIdentities=volume_name

AD-enables the specified volume.

nss /ADIdentities=all

AD-enables all the volumes. The volumes whose pools are not AD media-upgraded are ignored.

nss /(No)EnableNewVolumeToAD

Enables or disables the automatic AD-enabling of new volumes.

The commands placed in the `nssstart.cfg` file persists across server reboots. If this NSS command is added in the `nssstart.cfg` file, ensure this command is not prefixed with nss.

If this command is issued from the command line, it persists only till a server reboot.

Default: Off

Range: On or Off

Examples

To enable automatic AD-enabling of new volumes, enter

```
nss /EnableNewVolumeToAD
```

To disable automatic AD-enabling of new volumes, enter

```
nss /NoEnableNewVolumeToAD
```

AD-enabling of volumes can also be done using NSSMU (Section 10.2, "NSS Management Utility (NSSMU) Quick Reference," on page 108) and iManager (Section 19.1, "Understanding Volume Properties," on page 261).

5.3.2 Trustee Index Media

The Storage Services (NSS) volumes use the Trustee Model to secure access to directories and files. The Trustee Model allows you to assign users as trustees of directories and files on the NSS volumes. The model's inheritance function allows subdirectories and files to inherit rights from a parent directory or masks the rights that should not be inherited. The Trustee Index tree stores the list of directories and files in the NSS volumes that are having trustees and IRF (Inherited Rights Filter). The ZIDs (iNode number) in NSS consists of ACLs (with trustees and IRFs) that are stored in volumes in the Trustee Index tree. These ZIDs helps you to scan the trustee information for NURM, NFARM, and so on at any given path in NSS volume. Therefore, NSS requires a media upgrade to pool and volume to support Trustee Index. For more information on Trustee Model, see Section 6.5.3, "OES Trustee Model," on page 71.

Use the `nsscon` commands in this section to upgrade the existing NSS media to support Trustee Index or to enable all future NSS pool creation to be automatically created with the Trustee Index support.

For the Existing NSS Pools

nss /PoolMediaUpgrade=poolname /MediaType=TrusteeIndex

Upgrades the specified pool to support Trustee Index media.

For the Newly Created NSS Pools

The commands placed in the `nssstart.cfg` file persists across server reboots. If the NSS commands are added in the `nssstart.cfg` file, ensure those commands are not prefixed with nss.

If these commands are issued from the command line, it persists only till a server reboot.

nss /NewPoolMediaFormat=TrusteeIndex

Sets the file system media format of all the newly created pools (shared or local) to support Trustee Index media.

nss /NewPoolMediaFormat=TrusteeIndex /include=shared

Sets the file system media format of all the newly created shared pools to support Trustee Index media.

nss /NewPoolMediaFormat=TrusteeIndex /include=local

Sets the file system media format of all the newly created local pools to support Trustee Index media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015 SP1.

5.3.3 AES Media

To create encrypted volumes with an AES-256 encryption algorithm, use the NSS64 pool type with pool media upgraded to AES. The AES-256 encryption algorithm has longer key size and provides additional security compared to AES-128. Use the `nsscon` commands in this section to upgrade the existing NSS media to support AES or to enable all future NSS pool creation to be automatically created with the AES Index support.

For the Existing NSS Pools

nss /PoolMediaUpgrade=poolname /MediaType=AES

Upgrades the specified pool to support AES media.

For the Newly Created NSS Pools

The commands placed in the `nssstart.cfg` file persists across server reboots. If the NSS commands are added in the `nssstart.cfg` file, ensure those commands are not prefixed with nss.

If these commands are issued from the command line, it persists only till a server reboot.

nss /NewPoolMediaFormat=AES

Sets the file system media format of all the newly created pools (shared or local) to support AES media.

nss /NewPoolMediaFormat=AES /include=shared

Sets the file system media format of all the newly created shared pools to support AES media.

nss /NewPoolMediaFormat=AES /include=local

Sets the file system media format of all the newly created local pools to support AES media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2018 SP2.

5.4 Automatic Pool Media Upgrade

Use the following command to automatically upgrade the NSS32 and NSS64 pools to latest pool media (Trustee Index). The automatic pool media upgrade happens only if the pool is AD media enabled. Whenever an AD media enabled pool is activated, the pools are automatically upgraded to support latest media.

Media upgrading an NSS32 pool to AD, automatically upgrades the pool to latest media. However, creating an NSS64 pool, will automatically creates the pool with latest media.

The commands placed in the `nssstart.cfg` file persists across server reboots. If this NSS command is added in the `nssstart.cfg` file, ensure this command is not prefixed with nss.

If this command is issued from the command line, it persists only till a server reboot.

nss /(No)PoolMediaAutoUpgrade=*value*

Enables or disables the pool media to upgrade automatically. By default, it is set to Off. If enabled, the pools are automatically upgraded to support the latest media (Trustee Index). The possible values are ZLSS, ZLSS64, or both (with comma separated).

For more information, see Section A.13.2, “Automatic Pool Media Upgrade Commands,” on page 457.

NOTE: For clustered pools, the automatic pool media upgrade occurs only in homogeneous cluster environment. For local pools, the automatic pool media upgrade occurs both in homogeneous and mixed-node cluster environment.

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6 Planning NSS Storage Solutions

Consider what your storage needs are and how you can effectively manage and divide your storage space to best meet your needs. Use the information in this section to plan your storage deployment by using the OES Storage Services file system.

- Section 6.1, “Guidelines for NSS Storage,” on page 61
- Section 6.2, “Compatibility and Interoperability Issues for NSS,” on page 64
- Section 6.3, “Creating NSS Storage Objects in eDirectory,” on page 64
- Section 6.4, “Naming NSS Storage Objects,” on page 64
- Section 6.5, “Access Control for NSS,” on page 68
- Section 6.6, “File Access for Users,” on page 72
- Section 6.7, “Antivirus Support for NSS,” on page 74
- Section 6.8, “Backup Support for NSS,” on page 74
- Section 6.9, “NSS Support for Memory Mapped Files,” on page 75

6.1 Guidelines for NSS Storage

Use the guidelines in this section when planning your NSS storage solution:

- Section 6.1.1, “Devices,” on page 61
- Section 6.1.2, “Software RAID Devices,” on page 62
- Section 6.1.3, “Device Partitions,” on page 62
- Section 6.1.4, “NSS Pools and Volumes,” on page 62
- Section 6.1.5, “NSS Encrypted Volumes,” on page 63
- Section 6.1.6, “Storage Features,” on page 63

6.1.1 Devices

NSS recognizes the device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size). For more information, see Section 11.1.1, “Device Size,” on page 125.

Storage devices can be local to the server, such as a system hard drive, or external to the server, such as with direct-attached storage or in a Fibre Channel or iSCSI storage area network (SAN). For information about common device types, see Section 11.1.2, “Device Types,” on page 126.

A local hard drive typically contains the operating system software and can optionally be used for applications and user data.

If your system does not have sufficient power loss protection, you must use write-through cache management for SCSI devices to minimize the risk of losing data if there is a power failure. Write-through cache management assures the file system that writes are being committed to disk as required. For information, see Section 11.9, “Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers,” on page 136.

Understanding how much free space you will need from each device helps you during the disk carving phase of the NSS configuration. For information about space availability, see Section 11.2, “Viewing a List of Devices on a Server,” on page 129.

6.1.2 Software RAID Devices

NSS supports software RAIDs 0, 1, 5, 0+1, and 5+1. You can RAIDS 0, 1, and 5 in iManager or in NSSMU. RAIDs 0+1 and 5+1 can be created using NSSMU only.

If you use hardware RAID devices, software RAID devices are unnecessary. You can use both hardware and software RAID devices on the same server.

To maximize the performance benefits of software RAID devices, partitions used for the RAID should come from different physical devices. For software RAID 1 devices, the mirrored partitions cannot share any disks in common.

NSS software RAIDs can be used for local and clustered pools. You can use the same RAID0/5 device for multiple local pools. You can use multiple RAID0/5 devices to contribute space to a single pool. Any RAID0/5 device that is used for a clustered pool must contribute space exclusively to that pool; it cannot be used for other pools. This allows the device to fail over between nodes with the pool cluster resource. Ensure that its component devices are marked as Shareable for Clustering before you use a RAID0/5 device to create or expand a clustered pool.

For more information, see Section 14.1, “Understanding Software RAID Devices,” on page 183 and Section 14.2, “Planning for a Software RAID Device,” on page 185.

6.1.3 Device Partitions

NSS management tools automatically create and partitions for you on devices when you create and delete pools. For information, see Section 13.1, “Understanding Partitions,” on page 175.

6.1.4 NSS Pools and Volumes

NSS is used for data storage. You can create NSS pools and volumes to store data on devices managed by Linux Volume Manager (NLVM). The operating system and applications are stored on Linux POSIX volumes.

For prerequisites for creating a pool, see Section 16.1, “Guidelines for Creating a Pool,” on page 212.

When creating a pool, you can assign free space from multiple devices to create the maximum-sized pool of 8 TB. You can grow a pool dynamically by adding free space from the same device or different devices.

To mirror pools, each pool must use partitions from different devices; mirrored pools can have no devices in common.

Pools can contain multiple volumes, but a given volume belongs to only one pool.

Pools can be overbooked. If a pool contains multiple volumes, the cumulative administrative maximum sizes of all volumes can exceed the pool size by using the overbooking feature, although real total size is bound by physical limitations. Because space is allocated to volumes as needed, a volume might not reach its quota.

When creating a volume, assign it a fixed volume quota, or allow the volume to grow dynamically to the size of the pool. Any given volume's quota cannot exceed the size of the pool.

All devices that contribute space to a clustered pool must be able to fail over with the pool cluster resource. You must use the device exclusively for the clustered pool; do not use space on it for other pools or for Linux volumes. A device must be marked as Shareable for Clustering before you can use it to create or expand a clustered pool.

For guidelines for using volume attributes, see Section 19.1, "Understanding Volume Properties," on page 261.

For more guidelines for creating and managing NSS volumes, see Section 19.2, "Guidelines for NSS Volumes," on page 266.

6.1.5 NSS Encrypted Volumes

Encrypted Volume Support is available for data volumes. Create encrypted volumes only after you verify a successful system install or upgrade. For information, see "Understanding Encrypted Volume Support" on page 293.

6.1.6 Storage Features

Descriptions of the NSS storage features and guidelines for their use are located in sections that discuss the how to manage them. Table 6-1 identifies the features and provides links to the guidelines.

Table 6-1 *Guidelines for Using NSS Storage Features*

Storage Feature	Refer to
Pool snapshots	Section 18.1, "Understanding Pool Snapshots," on page 243 Section 18.2, "Guidelines for Using and Managing Pool Snapshots," on page 245 Section 8.1, "Cross-Platform Issues for NSS Pool Snapshots," on page 85
Compression	Section 22.1, "Understanding Compression," on page 319
Quotas	Section 23.1, "Understanding Space Quotas," on page 337
Salvage and purge	Section 24.1, "Understanding the NSS Salvage System," on page 351
Hard links	Section 25.1, "Understanding Hard Links," on page 363

Storage Feature	Refer to
Security	Chapter 21, “Securing Access to NSS Volumes, Directories, and Files,” on page 301 Chapter 31, “Security Considerations,” on page 427
Performance tuning	Chapter 28, “Tuning NSS Performance,” on page 395

6.2 Compatibility and Interoperability Issues for NSS

Table 6-2 lists references for compatibility and interoperability issues for NSS.

Table 6-2 *Compatibility and Interoperability Issues for NSS*

Known Issues	Refer to
Virtualization environments	Chapter 7, “Using NSS in a Virtualization Environment,” on page 77
Cross-platform issues	Chapter 8, “Cross-Platform Issues for NSS,” on page 85
Clustering NSS pools and volumes	Chapter 9, “Cluster-Enabling Shared NSS Devices and Pools with OES Cluster Services,” on page 89

6.3 Creating NSS Storage Objects in eDirectory

When you use NSSMU or iManager to create an NSS pool or volume on a server, a Storage object is automatically created in NetIQ eDirectory. By default, the name of the Storage object is the server’s name with an underscore and the object’s name appended (for example, `myserver_sys`). A Storage object represents a logical or physical object on a server, whether it is a writable disk, a CD, or other storage medium.

IMPORTANT: An NSS volume must have a Storage object in eDirectory to be able to participate in Distributed File Services.

For more information about NetIQ eDirectory, see the eDirectory website (https://www.netiq.com/documentation/edirectory-91/).

6.4 Naming NSS Storage Objects

Storage object names must be unique on a server. If the server is part of a cluster, then all pools and volumes must have unique names across all servers in the cluster, whether they are in shared relationships or not.

- Section 6.4.1, “Case Insensitive Names,” on page 65
- Section 6.4.2, “Number of Characters Allowed,” on page 65

- Section 6.4.3, “Conventions for Valid Names of NSS Storage Objects,” on page 66
- Section 6.4.4, “Other Naming Guidelines,” on page 66

6.4.1 Case Insensitive Names

NSS storage object names are case insensitive. Names such as AUR0RA, `Aurora`, and `aurora` are the same. NSS saves pool and volume names in uppercase. NSS software RAID device names and labels are case sensitive. For example, if you enter `MyRaid` as the name, it is saved as `MyRaid` only.

IMPORTANT: Because Linux treats filenames as case sensitive, when using NSS volumes on Linux, make sure to mount the volume with the Long name space (ns=long) option so that file queries are case insensitive. For information, see Section 19.11, “Mounting NSS Volumes with Linux Commands,” on page 278.

6.4.2 Number of Characters Allowed

For the NSS file system, the maximum length supported for a filename (the name and file extension) is 255 16-bit Unicode characters. The maximum length supported for the full path name (which includes the volume name, directories, filename, extension, and delimiters in the path) is 1023 16-bit Unicode characters. However, different tools, applications, and file systems place different limits on filenames and path lengths, some of which can be more or less restrictive than these limits. While it is possible to create a full path that is longer than 1023 characters, most tools will have difficulty dealing with it.

Use the guidelines in Table 6-3 to determine the length requirements for names of NSS Storage objects.

Table 6-3 *Storage Object Name and Password Length*

NSS Storage Object	Minimum Number of Characters (16-bit Unicode Characters)	Maximum Number of Characters (16-bit Unicode Characters)
Device name for a physical or logical device	2	15
Device name for a software RAID **NOTE:** RAIDs 0+1 and 5+1 can be created only from NSSMU.	2	15 (NSSMU) 58 (iManager) Longer names are truncated.
Partition label	2	128
Pool name	2	15
Volume name	2	15
Encryption password for encrypted NSS volumes. Use standard ASCII characters	2 (a minimum of 6 is recommended)	16

NSS Storage Object	Minimum Number of Characters (16-bit Unicode Characters)	Maximum Number of Characters (16-bit Unicode Characters)
Pathnames for files, including the server name, volume name, path delineators (such as colons, slashes, and dots), directory names, filename, and file extension	1	255

6.4.3 Conventions for Valid Names of NSS Storage Objects

Valid device, pool, and volume object names conform to the following naming conventions. We recommend that you also consider the character conventions for the software RAID names in order to have consistent naming policies on your system.

- Use only valid characters:

  ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789_!@#$%&( )

  NOTE:

  - Do not use the special characters !@#$%&() with the shared pool.
  - NSS software RAID device names are case sensitive. For example, if you enter MyRaid as the name, it is saved as MyRaid only.

  IMPORTANT: Special characters (non-alphanumeric) can create confusion or problems for some configuration files, command line utilities, applications, and scripts. For this reason, you should avoid using the ampersand (&), at (@), dollar sign ($), exclamation point (!), percent (%), and number sign (#) characters. For more information, see Section 6.4.4, “Other Naming Guidelines,” on page 66

- Do not use spaces in the object name.
- Do not begin or end the object name with an underscore (_).
- Do not use multiple contiguous underscores (__) anywhere in the object name.

IMPORTANT: OES Cluster services supports only alphanumeric characters and the underscore character in cluster resource names. Special characters (!@#$%&())are not supported. Because the pool name is automatically used in the pool cluster resource name, do not use special characters in pool names for pools that you plan to cluster enable.

6.4.4 Other Naming Guidelines

- In general, we recommend that you avoid using reserved names or words as names of Storage objects in order to avoid confusion.

  For example, the following case-insensitive names are reserved names:

  ALL
  AUX

CLOCK
COM1
COM2
COM3
COM4
CON
LPT1
LPT2
LPT3
NETQ
NUL
PIPE
PRN

- Some characters on Linux, such as the ampersand (&), dollar sign ($), exclamation point (!), and number sign (#) characters, can cause problems in some configuration files, command line utilities, applications, and scripts. You might need to use different techniques in each case to make the name be accepted in the manner intended. Refer to the documentation for the specific consumer application or utility to find how to treat names that contain special characters in that environment.

  To avoid this extra effort, we recommend that you avoid using special characters in names of Storage objects.

- Because the “at sign” (@) character (also called “the at symbol”) is an element of electronic mail addresses, such as `code@engineer.com`, it might cause confusion and possible problems in a Storage object name. A Web browser or other application could mistake it for an e-mail address.

  We recommend that you do not use the @ character in Storage object names.

- The percent character (%) might cause problems if it is passed in a format string to an application routine that uses it to delineate parameters. For example, if a volume name that contains the percent character, such as `store%sales`, is passed to an `(s)printf` routine, the `(s)printf` routine might look for parameters that are not there and crash.

  We recommend that you do not use the percent character in Storage object names.

- If spaces are used in User or Group object names, you must enclose the object name in double quotation marks (") in order for it to be recognized in command line utilities, scripts, and applications.

- If special characters are used in User or Group object names and passwords, you might need to use different escape techniques in command line utilities (such as Bash on Linux) to make the name be accepted in the manner intended. Refer to the documentation for the specific command line utility to find how to escape special characters in that environment.

  For example, enclosing the name in double quotation marks and preceding the character with a backslash are common techniques for escaping special characters when parsing command lines.

  To avoid this extra effort, we recommend that you avoid using special characters in names of User and Group objects and in passwords.

6.5 Access Control for NSS

This section describes how NetIQ eDirectory, NCP (NetWare Core Protocol) Server, and Linux User Management (LUM) work with Storage Services to provide access to NSS volumes on OES servers.

- Section 6.5.1, “Administrator User and Root User Roles for NSS,” on page 68
- Section 6.5.2, “NSS File System Users,” on page 69
- Section 6.5.3, “OES Trustee Model,” on page 71
- Section 6.5.4, “POSIX Permissions,” on page 71
- Section 6.5.5, “How NSS Uses OES Linux User Management,” on page 71

6.5.1 Administrator User and Root User Roles for NSS

The Administrator user and the Linux `root` user are two very different concepts. It is important to understand the role of each in managing the NSS volume.

- “Administrator User” on page 68
- “Root User” on page 69

Administrator User

The Administrator user is an eDirectory user who is given all file system trustee rights for the server, including the Supervisor right. The Administrator user account, or the Administrator equivalent user account, is given the following privileges:

- The user identity and credentials are defined in eDirectory.
- The user is assigned as a trustee of the NSS volume and given all file system trustee rights for that volume. You can also create a group for administrators with equivalent rights, and assign the user to that group.
- The username must be Linux-enabled with Linux User Management (LUM), which gives the user both an eDirectory GUID and a POSIX UID on the server.

  NOTE: You might see the user with the same eDirectory GUID even after LUM disabling the user. This is because NCP server clears its cache periodically at the interval of 30 minutes.

  During this time do not restart edirectory. Run `nsscon /ResetIDCache` after 30 minutes. For more information on ID Cache Commands, see Section A.5.2, “ID Cache Commands,” on page 443.

- The user belongs to the Administrator group for the server that is Linux-enabled with LUM.

The Administrator user who installs NSS on OES is automatically given these privileges. Any other administrator, including the Tree Administrator user, who you want to be able to manage the NSS storage must be manually configured with the same privileges.

IMPORTANT: The Tree Administrator user is not automatically granted permissions to OES servers installed in the tree.

For more information about Linux-enabled eDirectory users, see Section 6.5.2, “NSS File System Users,” on page 69.

For a Linux server, the administrator logs in to iManager as the Administrator user (or Administrator equivalent user) to manage the NSS volume. The Administrator user can also use the iManager Files and Folders plug-in, NetStorage, and the Client for Open Enterprise Server to manage file system trustee assignments, trustee rights, inherited rights masks, and file and directory attributes. These tools can also be used to purge and salvage files for volumes where the Salvage attribute is enabled.

Root User

The `root` user is a local Linux user who is the all-powerful connection when running on the Linux server. The `root` user is hardcoded internally in NSS to have all access rights to all files. In this way, the `root` user on Linux is similar to the Link Connection 0 user on NetWare.

The `root` user is not defined as a user in eDirectory, and the `root` user is not Linux-enabled with LUM. This allows you to log in to the server as the `root` user when eDirectory services are not available. The `root` user is the only local Linux user who is allowed to access NSS via the VFS layer without having an eDirectory GUID.

The `root` user logs in directly to the server to use NSS utilities (such as nsscon, nssmu, rights, attrib, metamig, ravsui, and raview) from the terminal console and to issue NSS command line commands from the NSS Console (NSSCON). The `root` user can also execute applicable Linux commands and utilities.

When accessing an NSS volume from the Linux environment, the `root` user observes some information differently, depending on whether the eDirectory user is Linux-enabled or not. Any native Linux commands that run from a terminal console on the NSS volume, such as the `ls` command, are sent via the VFS layer. If the users are not Linux-enabled, instead of seeing the local UID of the eDirectory user who owns the file, the `root` user sees all files as belonging to either the Nobody user (if it exists) or the `root` user.

IMPORTANT: NSS reports the Nobody UID or the `root` user UID for display purposes only; it does not change the true file ownership information stored as the user’s eDirectory GUID in the metadata of the file system.

6.5.2 NSS File System Users

In addition to the `root` user and Administrator user, file system users fall into three categories:

- “eDirectory Users” on page 70
- “Linux-Enabled eDirectory Users” on page 70
- “Local Linux Users” on page 71

eDirectory Users

NSS uses the eDirectory GUID of a user to control access by using the OES Trustee model. Users of the NSS volume and the Administrator user (or Administrator equivalent user) who manages the volume must be defined as users in NetIQ eDirectory. For information about managing users with eDirectory, see the eDirectory website (https://www.netiq.com/documentation/edirectory-91/).

To grant access to eDirectory users, you must assign them to be trustees in the file system, grant them file system trustee rights, and set inherited rights filters. For more information about configuring trustees for NSS, see Section 21.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 301.

Linux-Enabled eDirectory Users

Linux-enabled eDirectory users are users who are defined in eDirectory, granted file system trustee rights to the NSS volume, and Linux-enabled with Linux User Management. Linux-enabled eDirectory users have both a POSIX UID and an eDirectory GUID. You must Linux-enable users who need to access NSS volumes via NFS, third-party AFP solutions, or who need to use Linux utilities, commands, or services. NetStorage for Linux requires that users be Linux-enabled if NetStorage is configured to use OpenSSH for user access.

WARNING: When creating a LUM (Linux-Enabled eDirectory User) user consider the following:

- Do not assign the same UID as any local Linux users and the vice versa.
- Ensure that LUM user names do not conflict with any of the local Linux users name.

Assigning conflicting or duplicate UID's or LUM user names result in NSS access violations.

IMPORTANT: A Linux service or utility must also be enabled for LUM in order for users to access the file system with it.

For OES 2 and later, it is no longer necessary to Linux-enable the users with LUM in order for user quotas (space restrictions) to be enforced. NCP Server for Linux has been modified to provide the GUID information that NSS needs for file ownership. NSS uses file ownership information to enforce user space restrictions based on a user's eDirectory username.

Users who create hard links must be Linux-enabled in order to use the `ln` command on the server. It is not necessary to Linux-enable users if they are only consumers of the hard link.

Beginning in OES 2 SP2, if users are Linux-enabled with LUM or not, the file creator, modifier, and deleter fields are recorded with the username of the user who performs the action. In prior releases of OES 2, the deleter field is recorded as the `root` user or Nobody user (if it exists) if the user is not LUM enabled.

NOTE: In OES 1, the modifier field and deleter field are reported as the `root` user or Nobody user for non-LUM-enabled users.

For information about installing and configuring Linux User Management and enabling users and groups for Linux, see the *OES 2018 SP3: Linux User Management Administration Guide*.

Local Linux Users

Local Linux users are users who are defined locally for the Linux server. The `root` user is the only local Linux user who can see and access the NSS volume.

6.5.3 OES Trustee Model

NSS controls access to data based on the OES Trustee model, which uses file system trustee assignments, trustee rights, and inherited rights filters to control file access. The trustee model depends on the secure directory services provided by eDirectory to manage the file system users. For example, eDirectory users must be authenticated by eDirectory to connect to the server, and NSS uses the effective file system rights of the user to control access to specific files or directories.

For information about the OES Trustee model, see " Understanding File System Access Control Using Trustees" in the *OES 2018: File Systems Management Guide*.

6.5.4 POSIX Permissions

For NSS volumes, the POSIX directory and file permissions are not used to determine access permission. Access control is based on the OES trustee model and not on the POSIX permissions or access control lists (ACLs). NSS uses the POSIX permission fields to display Read Only, Read/Write, Execute, and Hidden attributes for directories and files. NSS does not use the Group ID field. Group ids associated with POSIX have no effect on files stored on NSS.

NSS does not allow the Linux system to set typical access control permissions in the POSIX fields. It interprets Linux `chmod` commands to apply the values as NSS directory and file attributes, according to the way NSS maps them to the User, Group, and Other permission fields.

By default, NSS sets the POSIX permissions fields for directories to 0777 (`drwxrwxrwx`). Some Linux services specify permissions needed to use the service. NSS provides the `nss /PosixPermissionMask=`*`mask`* option that allows you to change the default POSIX permissions, such as for the Group or Other fields.

For example, SSH requires that the POSIX permissions on home directories be set so that the Other field has no permissions. When you use NSS volumes as home directories, you must change the permission to 0770 on the home directories. You can use the `nss /PosixPermissionMask=0770` command in the NSS Console (`nsscon`) to modify the permissions.

For information and examples of how to interpret POSIX settings on your NSS volume, see "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *OES 2018: File Systems Management Guide*.

6.5.5 How NSS Uses OES Linux User Management

OES Linux User Management is a directory-enabled application that simplifies and unifies the management of user profiles on Linux-based platforms.

IMPORTANT: LUM is not required for access via NCP, OES AFP, and OES CIFS.

Linux-enabled eDirectory users have both UIDs as local Linux users and GUIDs as eDirectory users. NSS needs the UID to execute protocols and services that communicate to NSS through the VFS layer only. NSS uses the GUID to enforce access to the files and directories based on the OES Trustee model, which uses file system trustee assignments, trustee rights, and inherited rights filters.

With Linux protocols and services, the UID is passed to NSS via the VFS layer. There is no back-end XML call to exchange GUID information as there is with the NCP interface. NSS uses a LUM API to translate the UID to a GUID, and then caches the result for fast mapping on subsequent access by the same UID. With the GUID-UID mapping, NSS finds the GUID for the user who issues the command, then executes the command. Without LUM, NSS cannot identify a GUID for the UID it receives, and rejects the command with an error.

For information about installing and configuring LUM, enabling Linux services and utilities, and enabling users and groups for Linux, see the *OES 2018 SP3: Linux User Management Administration Guide*.

6.6 File Access for Users

NSS supports access via NCP and other protocols to eDirectory users and Linux-enabled eDirectory users.

IMPORTANT: NSS uses the OES trustee model for file access. Users must be made file system trustees and granted trustee rights to data on the NSS volume that you want them to be able to access. Rights management can be done in multiple management tools, including iManager, OES Remote Manager, the Client for Open Enterprise Server and other NCP services, and command line commands. For information, see Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301.

- Section 6.6.1, “NCP,” on page 72
- Section 6.6.2, “OES AFP,” on page 73
- Section 6.6.3, “OES CIFS,” on page 73
- Section 6.6.4, “OES Domain Services for Windows,” on page 73
- Section 6.6.5, “SSH (Secure Shell),” on page 74
- Section 6.6.6, “Accessing Files with Linux Services, Utilities, and Protocols,” on page 74

6.6.1 NCP

NCP (NetWare Core Protocol) is the default protocol for accessing data on NSS volumes. NCP Server is required for NSS even if users access the volume via other protocols. Users access data on NSS volumes by using the Client for Open Enterprise Server software on their Windows or Vista workstations. This document refers collectively to those workstations as “Clients for Open Enterprise Server”.

NCP Server is installed by selecting **NCP Server and Dynamic Storage Technology** from the **OES Services** menu in the YaST installation interface. For information about NCP Server, see the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

NCP Server works with NetIQ eDirectory, the Client for Open Enterprise Server, and other NCP-based services such as NetStorage to authenticate and manage user sessions. When NCP Server is running, eDirectory users who have been granted file system trustee access can access an NSS volume with the Client for Open Enterprise Server or NCP services. NSS cooperates with NCP Server to track file ownership and file system trustee assignments, trustee rights, and inherited rights based on the OES trustee model.

The Linux file system interface uses UTF-8 encoding for all filenames. When accessing files with NCP, ensure to use the UTF-8 enabled NCP software that is available in the latest Novell Client.

If you are converting NSS volumes from NetWare to Linux, make sure you have resolved any UTF-8 problems before moving the volume to Linux. For information, see *Supporting Mixed Language Environments with Novell NetWare* (TID 10097059) (http://support.novell.com/docs/Tids/Solutions/10097059.html) in the Micro Focus Support Knowledgebase.

For information about configuring and managing NCP Server, see the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

6.6.2 OES AFP

NSS supports access to NSS volumes using the OES AFP (Apple Filing Protocol). For OES 2 SP1 and later, AFP for Linux is installed by selecting **OES AFP** from the OES Services menu in the YaST install interface.

For information about AFP, see the*OES 2018 SP3: OES AFP for Linux Administration Guide*.

6.6.3 OES CIFS

NSS supports access to NSS volumes using CIFS. For OES 2 SP1 and later, OES CIFS is installed by selecting **OES CIFS** from the OES Services menu in the YaST install interface.

For information about OES CIFS, see the *OES 2018 SP3: OES CIFS for Linux Administration Guide*.

6.6.4 OES Domain Services for Windows

NSS supports access to NSS volumes using OES Domain Services for Windows (DSfW). DSfW configures Samba access for Samba/CIFS users. Administrators must export NSS volumes over Samba so that domain users (eDirectory users in the DSfW domain partition) can access NSS volumes over Samba/CIFS.

Samba/CIFS users under the domain are Linux-enabled with Linux User Management. The Domain Users group must be associated with the UNIX Workstation objects of the server (or servers if the volume is used in a cluster) where the volume is mounted in order to give the users access to the NSS volume via Samba/CIFS.

6.6.5 SSH (Secure Shell)

You can give users SSH (Secure Shell) access to NSS volumes by Linux-enabling users and the SSH utility in Linux User Management. For information, see the *OES 2018 SP3: Linux User Management Administration Guide*.

In addition, SSH requires that the POSIX permissions on home directories be set so that the Other field has no permissions. By default, NSS sets the POSIX permissions to 0777 and SSH is disabled in Linux User Management. If you use NSS volumes for home directories and you want users to have SSH access to them, you must modify the POSIX permissions on NSS volumes to 0770. You must also enable SSH with Linux User Management.

Add the following command in the `/etc/opt/novell/nss/nssstart.cfg` file to turn off all of the bits corresponding to the Other field:

```
/PosixPermissionMask=0770
```

The setting applies to all NSS volumes on the server. If the volume is shared in a cluster, make sure to add the command to the `nssstart.cfg` file and to Linux-enable SSH on all the nodes.

6.6.6 Accessing Files with Linux Services, Utilities, and Protocols

Only the `root` user and Linux-enabled eDirectory users who have been granted trustee access can see and access the NSS volume from a Linux interface. Users must be Linux-enabled with Linux User Management in order to use any of the standard Linux protocols, utilities, commands, services, or APIs for the NSS volume.

IMPORTANT: Any Linux service or utility that you want users to have access to must also be enabled in Linux User Management.

For information about installing and configuring Linux User Management, enabling users and groups for Linux, and enabling Linux services and utilities, see the *OES 2018 SP3: Linux User Management Administration Guide*.

6.7 Antivirus Support for NSS

Open Enterprise Server certifies the following antivirus software:

- Mcafee End Point Security 10.2.2
- Sophos 9.15.0.0.61

6.8 Backup Support for NSS

For information about backup support for NSS, see Chapter 27, “Managing Backup and Restore for Data and Trustee Information,” on page 389.

Open Enterprise Server certifies the following backup software:

- Micro Focus Data Protector 10.x

- SEP SESAM 4.4.3.64
- SyncSort DPX 4.5.2

6.9 NSS Support for Memory Mapped Files

NSS has limited support for memory mapped files, primarily to support loading programs. NSS does not fully support memory mapped files especially if the application uses sparse files.

For example, the CopyCat application used by Netatalk uses sparse files for its database. Netatalk tries to create a CopyCat database as a sparse file called `.AppleDB` in the root of the volume by using memory mapped IO. This can cause the server to hang if you are using an NSS volume as the Netatalk share because of the limited support in NSS for this combination.

7 Using NSS in a Virtualization Environment

Use the information in this section to help you deploy OES Storage Services file system and services in a virtualization environment.

To get started with Xen virtualization, see the Virtualization with Xen documentation.

- Section 7.1, “Guidelines for Using NSS in a Xen Virtualization Environment,” on page 77
- Section 7.2, “Installing OES on a Virtual Machine,” on page 81
- Section 7.3, “Initializing New Virtual Disks on the Guest Server,” on page 82
- Section 7.4, “What’s Next,” on page 84

NOTE: To get started with third-party virtualization platforms, such as Hyper-V from Microsoft and the different VMware offerings, refer to the documentation for the product that you are using.

7.1 Guidelines for Using NSS in a Xen Virtualization Environment

Consider the following guidelines when planning to use NSS in a virtualization environment:

- Section 7.1.1, “Host Server Issues,” on page 77
- Section 7.1.2, “Virtual Machine Issues,” on page 79
- Section 7.1.3, “Guest Server Issues,” on page 81

7.1.1 Host Server Issues

- “Running NSS on the Host Server Is Not Supported” on page 77
- “Using RAIDs” on page 78
- “Using Multipath Devices” on page 78

Running NSS on the Host Server Is Not Supported

NSS pools and volumes are not supported on the Xen host server in a Xen virtualization environment. You can install NSS on the guest servers from inside the guest server environment, just as you would if the guest servers were physical servers.

When you create a virtual machine, you must assign devices to it. If you plan to use the virtualization guest server as a node in a cluster and you need to be able to fail over cluster resources to different physical servers, you must assign SAN-based physical devices to the virtual machine. You create the NSS pools and volumes from within the guest server.

If you install OES Cluster Services in the host server environment, the cluster resources use shared Linux POSIX volumes, and do not use shared NSS pools.

If you install OES Cluster Services in the guest server environment, the guest server is a node in the cluster. The disk sharing is managed by Cluster Services from within the guest server environment. You can use shared NSS pools as cluster resources that run on the guest server and on other nodes in that cluster.

For information about deployment scenarios using shared NSS pools in clusters in a virtualization environment, see "Configuring OES Cluster Services in a Virtualization Environment" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

Using RAIDs

In a Xen virtualization environment, if you need to use RAIDs for device fault tolerance in a high-availability solution, we recommend that you use standard hardware RAID controllers. Hardware RAIDs provide better performance over using software RAIDs on the virtualization host server or guest server.

To get the best performance from a software RAID, create a RAID device on the Xen host and present that device to the guest VM. Each of the RAID's segments must be on different physical devices. It is best to present the entire physical RAID device or a physical partition of the RAID device to the guest VM, and to not present just a file-backed virtual device.

NSS is not supported to run in the virtualization host server environment, so NSS software RAIDs cannot be used there. Xen supports using Linux `mdadm` for software RAIDs on the host server.

If you attempt to create and manage a software RAID on the guest server in a production environment, make sure to present different physical devices to the guest VM that you want to use for the software RAID. Using segments from virtual devices that actually reside on the same physical device on the host server slows performance and provides no protection against failed hardware devices. The maximum number of disks that can be presented to the VM is 16 (`xvda` to `xvdp`). Xen provides a mechanism to dynamically add and remove drives from a VM.

Using NSS software RAIDs in a virtualization guest server environment has not been tested.

Using Multipath Devices

If it is available, use your storage vendor's multipath I/O management solution for the storage subsystem. In this case, the multiple paths are resolved as a single device that you can assign to a virtual machine.

Do not use multipath management tools in the guest environment.

If a storage device has multiple connection paths between the device and the host server that are not otherwise managed by third-party software, use Linux multipathing to resolve the paths into a single multipath device. When assigning the device to a VM, select the device by its multipath device node name (`/dev/mapper/mpathN`). The guest server operating system is not aware of the underlying multipath management being done on the host. The device appears to the guest server as any other physical block storage device. For information, see Managing Multipath I/O for Devices (https://www.suse.com/documentation/sles-12/stor_admin/data/cha_multipath.html) in the SLES 12: Storage Administration Guide (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).

7.1.2 Virtual Machine Issues

- "Assigning Physical Disks or Disk Partitions to the Virtual Machine" on page 79
- "Assigning File-Backed Disk Images for Virtual Devices" on page 79
- "Configuring I/O Scheduler for NSS on XEN Virtual Machine" on page 79

Assigning Physical Disks or Disk Partitions to the Virtual Machine

For the best performance on a Xen guest server, NSS pools and volumes should be created on block storage devices that are local SCSI devices, Fibre Channel devices, iSCSI devices, or partitions on those types of devices.

SATA or IDE disks have slower performance because the Xen driver requires special handling to ensure that data writes are committed to the disk in the order intended before it reports.

Assigning File-Backed Disk Images for Virtual Devices

OES supports file-backed disk images on virtual machines, but does not recommend using them for important data because the volume can become corrupt after a power failure or other catastrophic failure. For example, file-backed volumes might be useful for training and sales demonstrations.

WARNING: Data corruption can occur if you use Xen file-backed disk images for NSS volumes on the guest server in the event of a power failure or other catastrophic failure.

Configuring I/O Scheduler for NSS on XEN Virtual Machine

OES kernel has four I/O schedulers available to choose from for custom configuration. They each offer a different combination of optimizations. The four Types of Linux I/O Schedulers are the following:

- NOOP Scheduler
- Deadline Scheduler
- Anticipatory Scheduler
- Completely Fair Queuing (CFQ) Scheduler

The NOOP scheduler is the simplest of all the I/O schedulers. It merges requests to improve throughput, but otherwise attempts no other performance optimization. All requests go into a single unprioritized first-in, first-out queue for execution. It is ideal for storage environments with extensive caching, and those with alternate scheduling mechanisms—a storage area network with multipath access through a switched interconnect, for instance, or virtual machines, where the hyperviser provides I/O backend. It's also a good choice for systems with solid-state storage, where there is no mechanical latency to be managed.

The Deadline scheduler applies a service deadline to each incoming request. This sets a cap on per-request latency and ensures good disk throughput. Service queues are prioritized by deadline expiration, making this a good choice for real-time applications, databases and other disk-intensive applications.

The Anticipatory scheduler does exactly as its name implies. It anticipates that a completed I/O request will be followed by additional requests for adjacent blocks. After completing a read or write, it waits a few milliseconds for subsequent nearby requests before moving on to the next queue item. Service queues are prioritized for proximity, following a strategy that can maximize disk throughput at the risk of a slight increase in latency.

The *Completely Fair Queuing (CFQ) scheduler* provides a good compromise between throughput and latency by treating all competing processes even-handedly. Each process is given a separate request queue and a dedicated time slice of disk access. CFQ provides the minimal worst-case latency on most reads and writes, making it suitable for a wide range of applications, particularly multi-user systems.

For OES on XEN guest, the default is NOOP scheduler. To improve the I/O scheduler performance, change the default NOOP scheduler to CFQ. Perform the following steps to view and change the I/O scheduler after OES installation:

To view the current scheduler, enter the following command:

```
cat /sys/block/{DEVICE-NAME}/queue/scheduler
```

To change the scheduler to CFQ, enter the following command:

```
echo cfq > /sys/block/{DEVICE-NAME}/queue/scheduler
```

For example, your device name is sda. To view the scheduler, enter the following command:

```
cat /sys/block/sda/queue/scheduler
```

and the output received is the following:

```
[noop] anticipatory deadline cfq
```

To change the current NOOP scheduler to CFQ, enter the following command:

```
echo cfq > /sys/block/sda/queue/scheduler
```

The optimization in OES can also be achieved during the boot time at a global level. To achieve that, perform the following:

Add the elevator option to your kernel command in the GRUB boot loader configuration file (`/boot/grub/menu.lst`) and then reboot. For example,

```
kernel /vmlinuz-2.6.16.60-0.46.6-smproot=/dev/disk/by-id/scsi-
SATA_WDC_WD2500YS-23_WD-WCANY4424963-part3 vga=0x317 resume=/dev/sda2
splash=silent showopts elevator=cfq
```

or

Using YaST2, edit the optional kernel command line parameter under **System > Boot Loader** for the booting kernel image or any other kernel image listed and add `elevator=cfq`. For more information on editing and using the boot loader configuration, see Configuring the Boot Loader with YaST (https://www.suse.com/documentation/sles-12/book_sle_admin/data/sec_grub2_yast2_config.html).

7.1.3 Guest Server Issues

Consider the issues in this section for the OES server running in the Xen host environment:

- “Initializing Virtual Disks” on page 81
- “NSS Features that Are Not Supported in a Virtualization Environment” on page 81

Initializing Virtual Disks

The primary virtual disk (the first disk you assign to the virtual machine) is automatically recognized when you install the guest operating system. The other virtual devices must be initialized before any space is shown as available for creating a pool. Without initializing the devices, no space is shown as available for pool creation. For information, see Section 7.3, “Initializing New Virtual Disks on the Guest Server,” on page 82.

NSS Features that Are Not Supported in a Virtualization Environment

Some NSS features are not supported in a Xen guest server environment.

Table 7-1 *NSS Feature Support in a Guest Server Environment*

NSS Feature	NSS on Virtualized Linux Environment
Data shredding	Not supported
Multipath I/O	Not applicable; not supported on Linux
Software RAIDs	Not tested

7.2 Installing OES on a Virtual Machine

When you install OES on a virtual machine, we recommend that you configure a virtual machine with multiple devices. Use the primary disk on the guest server as the system device with LVM2 (the YaST install default) as the volume manager. After the install, assign additional storage resources from the host to the virtual machine. In this scenario, NSS volumes are created only on the data disks for the guest server, not on the system disk that you are using for the guest server’s system device.

IMPORTANT: When you create the virtual machine, make sure to configure the size of the primary virtual disk according to the amount of space you need for the boot (`/boot`), `swap`, and root (`/`) volumes.

For information about creating a Xen virtual machine, see Virtualization with Xen documentation.

7.3 Initializing New Virtual Disks on the Guest Server

A new virtual disk can appear as an unformatted disk to the guest server if it does not have a partition table associated with it. You must initialize the device on the guest server just as you do for a blanked-out device on a physical server.

The primary virtual disk (the first disk you assign to the virtual machine) is automatically recognized when you install the guest operating system. After the install, use NSS tools to initialize additional blanked-out virtual devices where you plan to create NSS pools and volumes.

You can initialize the disk by using the **Initialize Disk** function in NSSMU or in the Storage plug-in to iManager. For general instructions for initializing disks, see Section 11.5, “Initializing a Disk,” on page 132.

To initialize devices for the guest server:

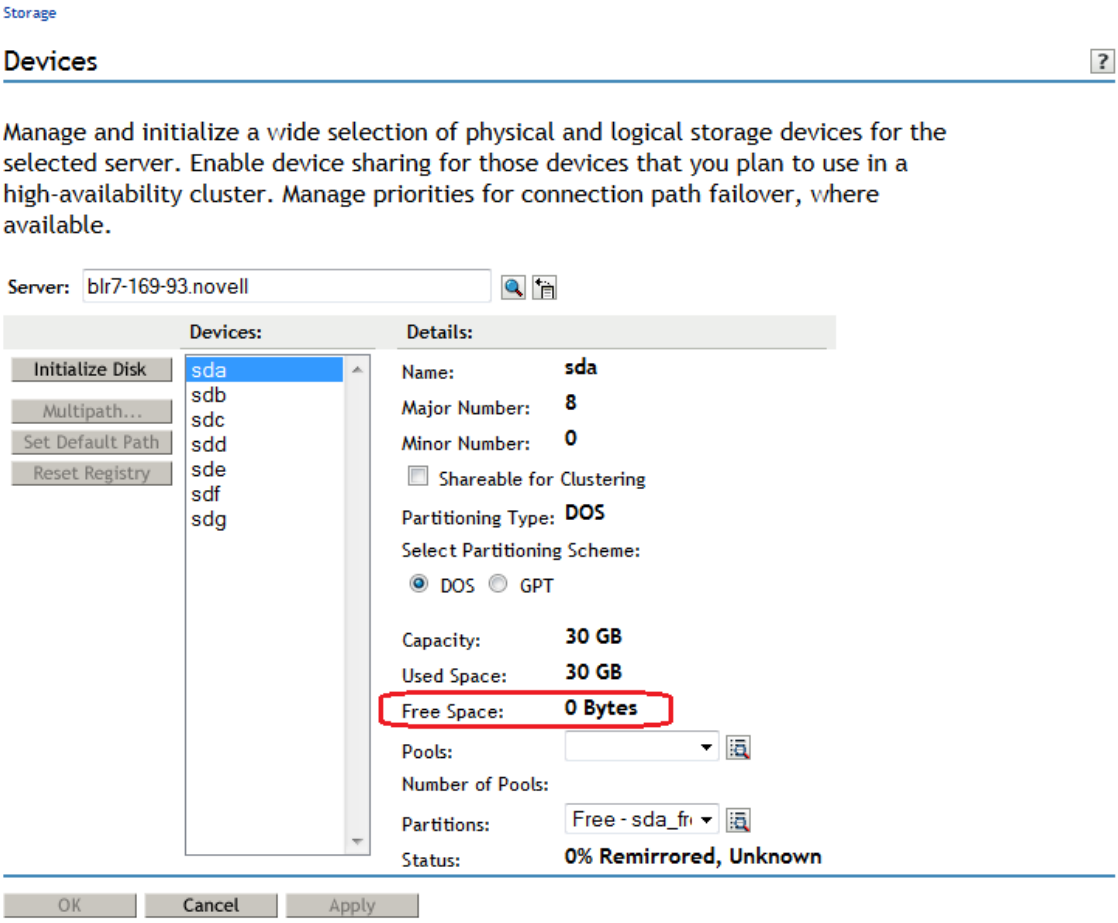
1. On the host, use the virtualization management tool to create and allocate virtual devices for the virtual machine.

   For information, see Virtualization with Xen documentation.
2. If the guest server is not running, boot the guest server now.
3. In iManager, click **Storage > Devices.**
4. Browse to locate and select the guest server to view a list of its devices.

   The virtual server has a Server object in the NetIQ eDirectory database, just like a physical server.
5. In the **Devices** list, select the newly added virtual device to view its details.
6. Verify that the device you selected is the new unformatted device, and not your system device or a formatted device.

   WARNING: Do not initialize the system disk.

   For example, for an unformatted device, the **Free Space** size is reported as 0.00 Bytes.

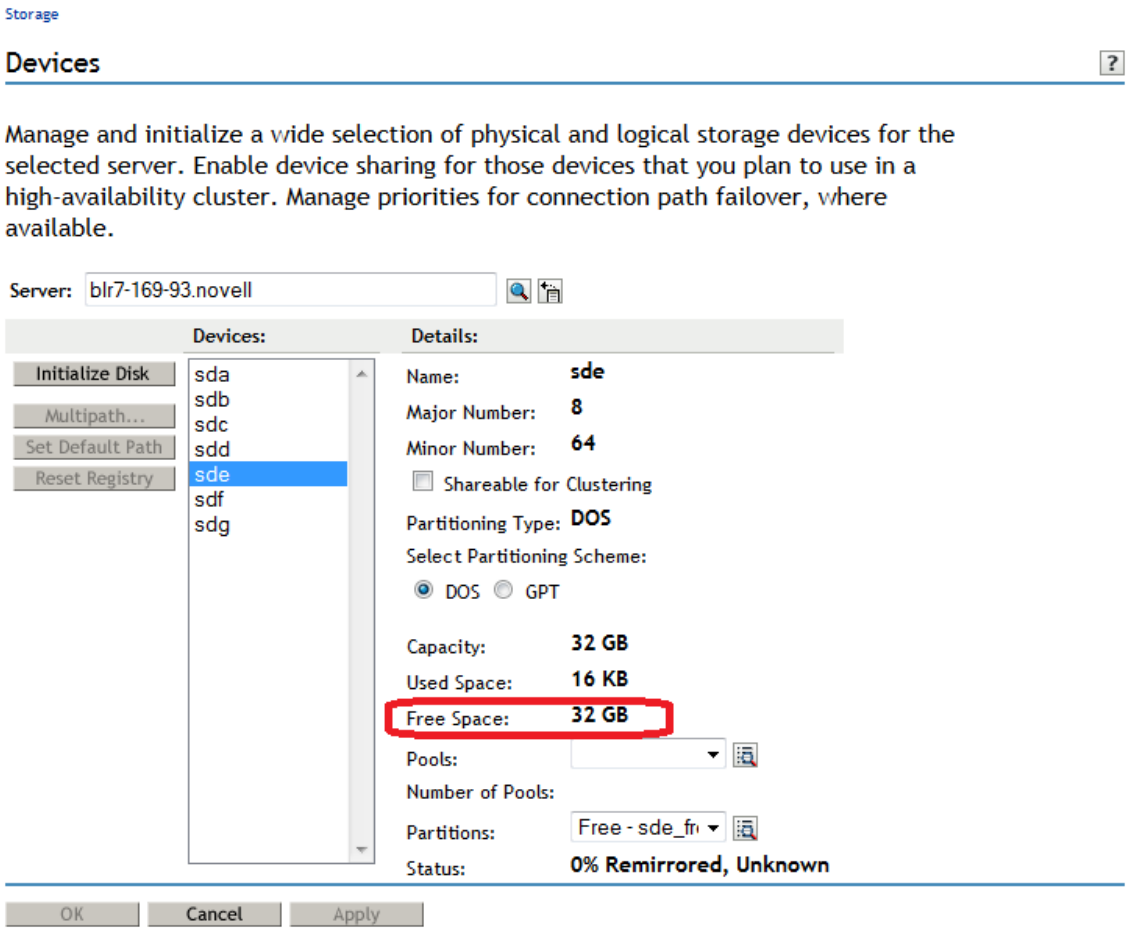


7 Click **Initialize**.

When the page refreshes, the device is initialized and available for further configuration with NSS pools and volumes.

8 Verify that the **Free Space** is now reported properly.

For example, after the device is initialized, the **Free Space** is reported to be the same as **Capacity**.



7.4 What's Next

To get started with virtualization, see Virtualization with Xen documentation.

For information on setting up virtualized OES, see Installing, Upgrading, or Updating OES on a VM in the OES 2018 SP3: Installation Guide.

8 Cross-Platform Issues for NSS

This section describes the cross-platform compatibility issues for the OES Storage Services file system and services between NetWare and Open Enterprise Server servers. You should understand these differences when working with NSS.

- Section 8.1, “Cross-Platform Issues for NSS Pool Snapshots,” on page 85
- Section 8.2, “Cross-Platform Issues for NSS Volumes,” on page 85
- Section 8.3, “Cross-Platform Issues for NSS Features,” on page 86
- Section 8.4, “Cross-Platform Issues for File Access,” on page 87
- Section 8.5, “Cross-Platform Issues for Management Tools,” on page 87

8.1 Cross-Platform Issues for NSS Pool Snapshots

Different pool snapshot technologies are used for NSS pools on NetWare and NSS pools on Linux. You can create pool snapshots on either platform, but you should not move them to another platform. Pool snapshots taken on NetWare do not work on Linux, and vice versa.

Consider these guidelines when working with NSS pool snapshots:

- The snapshots taken on a given platform are unusable if you move the pool’s devices cross-platform. Before you move a pool with existing snapshots to a different platform, delete all existing snapshots for the pool.

  WARNING: You might not be able to open the original pool on the other platform if you do not delete the snapshots.

- NSS does not support using pool snapshots for clustered pools.
- Do not use the Pool Snapshot feature for a clustered pool in a mixed-platform cluster.
- You must remove any existing pool snapshots for a clustered pool on NetWare before you cluster migrate the pool cluster resource from a NetWare server to a Linux server in a mixed-platform cluster. (Mixed-platform clusters are supported only during a rolling cluster conversion.)

8.2 Cross-Platform Issues for NSS Volumes

OES requires a Linux POSIX file system volume for the operating system, such as Ext3. If you plan to move NSS pools and volumes cross-platform between NetWare and Linux servers, consider the following guidelines:

- You cannot install the Linux operating system on an NSS volume.
- You cannot install the NetWare operating system on a Linux POSIX file system volume or on an NSS volume on Linux.

- Use NSS on Linux only as data pools and volumes.
- You should not move an NSS system volume from NetWare to Linux unless you intend to use it as a data volume (or not at all) while it is mounted on the Linux server.

  At install time, OES sets up a sys: volume on a Linux POSIX file system with the Linux path of `/usr/novell/sys`, and creates an NCP volume for it in the `/etc/opt/novell/ncpserv.conf` file. The sys: volume contains the same login and public directories that exist on NetWare. These directories let Novell clients run commands for logging in, mapping drives, and so on, as well as providing the means for client commands to be run from login scripts.
- NSS volumes that were originally created on NetWare can be moved cross-platform from NetWare to Linux if both platforms support the same media format.
- If you use shared pools in a cluster, only pools that are originally created on NetWare can be migrated or failed back from Linux to NetWare. Mixed-platform clusters are supported only for rolling cluster conversions from NetWare to Linux.

8.3 Cross-Platform Issues for NSS Features

The following features of NSS on NetWare are not available for NSS on Linux. Use the native Linux alternatives where available.

- Section 8.3.1, “Multipath I/O to Devices,” on page 86
- Section 8.3.2, “Removable Media,” on page 86
- Section 8.3.3, “Transaction Tracking System,” on page 86

8.3.1 Multipath I/O to Devices

The Media Manager solution for multipath I/O handling is not available for NSS on Linux. Use the Linux multipath I/O management tools. You should configure multipath I/O before using NSS management tools to create NSS software RAIDs, pools, or volumes on the devices. For information, see Chapter 15, “Managing Multipath I/O to Devices,” on page 209.

8.3.2 Removable Media

Removable media such as CDs, DVDs, CD and DVD image files, and DOS partitions are typically mounted as file systems native to the Linux platform. Removable media and partitions are mounted by using Linux POSIX file systems options. For information, see “Other Supported File Systems” (https://www.suse.com/documentation/sles-12/stor_admin/data/sec_filesystems_other.html) in the *SUSE Linux Enterprise Server 12 SP2 Storage Administration Guide* (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).

8.3.3 Transaction Tracking System

The NSS Transaction Tracking System (TTS) is not available for NSS on Linux.

8.4 Cross-Platform Issues for File Access

Users of the NSS volume must be Linux-enabled with Linux User Management if you want to give users access via any native Linux protocol or any Linux service or utility, such as FTP or SSH. You must also LUM-enable the Linux service or utility. For information, see Section 6.5, “Access Control for NSS,” on page 68.

8.5 Cross-Platform Issues for Management Tools

- Section 8.5.1, “Storage-Related Plug-Ins for iManager 3.2.1,” on page 87
- Section 8.5.2, “Interoperability of Protocols for the iManager Server and Target Server,” on page 87
- Section 8.5.3, “Management Capabilities for Software RAIDs,” on page 88

8.5.1 Storage-Related Plug-Ins for iManager 3.2.1

The following storage-related plug-ins for OES 2 and later require iManager 2.7 (or later):

Storage-Related Plug-In	NSS on Linux	NSS on NetWare
Archive and Versioning (Archive and Version Services)	Yes	Yes
Clustering (OES Cluster Services)	Yes	Yes
Distributed File Services (OES Distributed File Services)	Yes	Yes
OES AFP	Yes (OES 2 SP1 and later)	Yes
OES CIFS	Yes (OES 2 SP1 and later)	Yes
OES NFS	No	Yes
Files and Folders	Yes	Yes
Storage (NSS file system)	Yes	Yes

For more information about storage-related plug-ins, see Section 10.1.1, “Understanding Storage-Related Plug-Ins,” on page 94.

8.5.2 Interoperability of Protocols for the iManager Server and Target Server

Table 10-3 in “Protocols for iManager Communications” on page 98 provides information about the protocols needed to use iManager to manage storage in a heterogeneous environment.

8.5.3 Management Capabilities for Software RAIDs

NSSMU supports creating nested RAID 0+1 and 5+1 devices.

9 Cluster-Enabling Shared NSS Devices and Pools with OES Cluster Services

Shared OES Storage Services devices and pools can be used in a cluster environment by using OES Cluster Services on your Open Enterprise Server 2015 (OES 2015) or later servers. The NSS software is not clustered and must be installed and running on every server in the cluster.

- Section 9.1, “Cluster-Enabling NSS Pools and Volumes,” on page 89
- Section 9.2, “Guidelines for Cluster-Enabling NSS,” on page 89

9.1 Cluster-Enabling NSS Pools and Volumes

For information about installing OES Cluster Services and cluster-enabling shared NSS devices and pools in the OES Cluster Services clusters, see “Configuring and Managing Cluster Resources for Shared NSS Pools and Volumes” in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

For NetWare 6.5 SP8 to OES 2018 SP2, see “Managing File Systems in Mixed-Mode Clusters” in the *OES 2015 SP1: Novell Cluster Services NetWare to Linux Conversion Guide*.

9.2 Guidelines for Cluster-Enabling NSS

OES Cluster Services must already be installed and configured on the server. Table 9-1 provides references for cluster-related tasks for NSS.

Table 9-1 *Clustering Guidelines for NSS*

NSS Feature	Description	Reference
Shared device	Enable the Shareable for Clustering parameter to support high-availability server clusters with OES Cluster Services.	Section 11.6, “Sharing Devices,” on page 133
Shared pools	Enable the pool for clustering when you create the pool. Devices contributing space to the pool must already be marked as shareable in order to be able to create a shared pool. Unshared pools can be created on shared devices. Pools created on NetWare can fail over to a Linux node in a mixed-node cluster, but only pools that were originally created on NetWare can fail back from Linux to NetWare.	Section 16.2, “Creating a Pool,” on page 212
Multiple Server Activation Prevention (MSAP) for pools	MSAP prevents some accidental activations of a pool on more than one server at a time. MSAP is enabled by default.	Section 16.14, “Preventing Pools from Activating on Multiple Servers,” on page 225

NSS Feature	Description	Reference
Pool snapshot	On Linux, NSS does not support using pool snapshots for clustered pools. You must remove any existing pool snapshots for a clustered pool on NetWare before you cluster migrate the pool cluster resource from a NetWare server to a Linux server during a rolling cluster conversion. **WARNING:** You might not be able to open the original pool on Linux if you do not delete the snapshots before you attempt to cluster migrate the pool cluster resource from NetWare to Linux.	"Cross-Platform Issues for NSS Pool Snapshots" on page 85
Shared volumes	You must create at least one shared volume in a cluster-enabled pool. We recommend using only one volume per pool in a cluster. Typically, all volumes are created when you initially set up the cluster resource and before you need to cluster migrate or fail over the resource to other servers in the cluster. The Server, Pool, Volume, Cluster Resource, and Cluster objects are recommended to be in the same context (such as ou=ncs,o=microfocus). If the objects are in different contexts, you might receive an eDirectory error when you attempt to modify the pool, create or modify the volumes, home directories, Distributed File Services junctions, or any other elements that are managed using eDirectory objects. To resolve the problem, you must cluster migrate the pool cluster resource back to the node where the pool was created in order to perform those management tasks.	Section 19.2.4, "Guidelines for NSS Volumes in a Mixed-Node Cluster," on page 268
Shared encrypted volume	When shared pools contain encrypted volumes, you must provide the encryption password the first time that a volume is mounted after a reboot. Thereafter, the nodes in the cluster share the key.	"Sharing Encrypted NSS Volumes in a Cluster" on page 296 "Using Encrypted Volumes in a Server Cluster" on page 298
Shadow volume pair using Dynamic Storage Technology	When a shared pool contains a volume that is part of a shadow volume pair, the other volume in the shadow pair can reside on the same pool or in a different pool on the same server. If it is on a different pool, both pools must be managed by the same cluster resource. In a cluster, shadow volumes can reside on and fail over only to nodes running OES 2 or later servers.	*OES 2018 SP3: Dynamic Storage Technology Administration Guide*

Cluster-Enabling an Existing NSS Pool and Its Volumes

Before you attempt to cluster-enable an existing pool and its volumes, the pool should be deactivated and its volumes should be dismounted.

Comment out (or remove) the volume's entry in the `/etc/fstab` file. The load and unload scripts that are created when you cluster-enable the pool will be responsible for mounting and dismounting the volume after the pool is cluster enabled. If you leave `/etc/fstab` as-is, the server will continue to try and mount the NSS volume on reboot, but it will not succeed. For information about cluster-enabling an existing pool and its volumes, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the OES Cluster Services for Linux Administration Guide.

10 Management Tools for NSS

This section identifies the various tools for managing the OES Storage Services file system.

- Section 10.1, “iManager and Storage-Related Plug-Ins,” on page 93
- Section 10.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 108
- Section 10.3, “NSS Commands and Utilities,” on page 116
- Section 10.4, “OES NetStorage,” on page 117
- Section 10.5, “OES Remote Manager,” on page 119
- Section 10.6, “Client for Open Enterprise Server,” on page 121
- Section 10.7, “Virtual File Services, APIs, and Scripts,” on page 122
- Section 10.8, “OES Linux Volume Manager (NLVM),” on page 123

NOTE

- NSS also supports the use of third-party tools on both kernels for advanced data protection and management, virus scanning, and traditional archive and backup solutions.
- ConsoleOne is no longer supported by Micro Focus. In an NSS file system, ConsoleOne was used to manage trustees and attributes for directories and files. Beginning with OES 2015, all these operations can be performed using the latest iManager. Ensure that you have applied the latest patches and have installed the latest iManager plug-ins. For more information, see Section 21.1.6, “Managing Rights,” on page 308.

10.1 iManager and Storage-Related Plug-Ins

iManager is a Web browser-based tool used for configuring, managing, and administering eDirectory objects on your network. The Storage plug-in is the primary tool used to manage NSS devices, software RAIDs, pools, and volumes.

iManager gives you the ability to assign specific tasks or responsibilities to user accounts and to present the user with only the tools (with the accompanying rights) necessary to perform those sets of tasks.

NOTE: The storage-related plug-ins do not support Mobile iManager.

This section describes the following:

- Section 10.1.1, “Understanding Storage-Related Plug-Ins,” on page 94
- Section 10.1.2, “Prerequisites for Using the Storage-Related Plug-Ins,” on page 97
- Section 10.1.3, “Downloading and Installing Plug-In Updates,” on page 99
- Section 10.1.4, “Accessing iManager,” on page 99
- Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100

- Section 10.1.6, “Selecting a Server to Manage,” on page 100
- Section 10.1.7, “Storage Plug-In Quick Reference,” on page 101
- Section 10.1.8, “Files and Folders Plug-In Quick Reference,” on page 106

10.1.1 Understanding Storage-Related Plug-Ins

Storage-related plug-ins share some management code in common. It is necessary to manage these plug-ins together when installing or updating any of the plug-ins.

- “Overview of the Storage-Related Plug-Ins for iManager” on page 94
- “Archive Versioning Management” on page 95
- “Cluster Services Management” on page 95
- “Distributed File Services Management” on page 95
- “Files and Folders Management” on page 95
- “File Protocols Management (AFP and CIFS)” on page 96
- “Samba Management” on page 96
- “NSS Management” on page 96
- “Storage Management” on page 96
- “Files for Storage-Related Plug-Ins” on page 96

Overview of the Storage-Related Plug-Ins for iManager

Table 10-1 identifies the storage-related plug-ins for iManager in OES 2 SP2 and later.

Table 10-1 *Storage-Related Plug-Ins for iManager*

Storage-Related Plug-In	NPM File	Role in iManager	Use to Manage
Archive Versioning Management	`arkmgmt.npm`	Archive Versioning	OES Archive and Version Services
Cluster Services Management	`ncsmgmt.npm`	Clusters	OES Cluster Services
Distributed File Services Management	`dfsmgmt.npm`	Distributed File Services	OES Distributed File Services
Files and Folders Management	`fileman.npm`	Files and Folders	OES Files and Folders
AFP Management	`afpmgmt.npm`	File Protocols > AFP	OES AFP for Linux OES AFP for NetWare
CIFS Management	`cifsmgmt.npm`	File Protocols > CIFS	OES CIFS for Linux OES CIFS for NetWare
Samba Management	`sambamgmt.npm`	File Protocols > Samba	OES Samba
NSS Management	`nssmgmt.npm`	Storage	OES Storage Services

Storage-Related Plug-In	NPM File	Role in iManager	Use to Manage
Storage Management	`storagemgmt.npm`	No role. Required when using any combination of storage-related plug-ins	Contains common code for all storage-related plug-ins

IMPORTANT: The storage-related plug-ins share code in common in the `storagemgmt.npm` file. If you use more than one of these plug-ins, you should install, update, or remove them all at the same time to make sure the common code works for all plug-ins. If you remove only one of the plug-ins, it removes the common code and breaks the remaining installed plug-ins.

Archive Versioning Management

The Archive Versioning Management (`arkmgmt.npm`) file contains the Archive Versioning plug-in for OES Archive and Version Services. This plug-in requires the NSS Storage Management plug-in.

Cluster Services Management

The Cluster Services Management (`ncsmgmt.npm`) file contains the Clustering plug-in for managing OES Cluster Services. This plug-in requires the Storage Management plug-in. The NSS Storage Management plug-in is required for cluster-enabling NSS pools and volumes.

For information about using this plug-in, see *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

Distributed File Services Management

Use the Distributed File Services plug-in to manage OES DFS for NSS volumes. The DFS plug-in also requires the NSS Storage Management and Storage Management plug-ins.

For information about using the DFS plug-in, see *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.

Files and Folders Management

Provides a file tree view for managing and browsing files and eDirectory objects.

When NCP Server is installed, this plug-in supports the OES Trustee Model of access control for OES Storage Services (NSS) volumes on Linux and NetWare and for NetWare Core Protocol volumes on Linux POSIX file systems. Use it to manage the file system trustees, trustee rights, and inherited rights filters for files and folders on NSS and NCP volumes. On Linux, install the NCP Server and Dynamic Storage Technology service. On NetWare, the NCP Server service is automatically installed.

For file systems that have Volume objects in eDirectory, this plug-in allows you to upload, download, and delete files and to create and delete directories. For NSS volumes, it provides additional features that allow you to manage file system attributes, to salvage and purge deleted files and folders, and to manage directory quotas.

File Protocols Management (AFP and CIFS)

Beginning in OES 2 SP2, the File Protocols plug-in for the Native File Access Protocols for NetWare services has been replaced by two plug-ins: OES AFP (`afpmgmt.npm`) and OES CIFS (`cifsmgmt.npm`). These plug-ins support AFP and CIFS services for NSS volumes on both Linux and NetWare.

The AFP and CIFS plug-ins also require the NSS Storage Management (`nssmgmt.npm`) and Storage Management (`storagemgmt.npm`) plug-ins.

IMPORTANT: Make sure to uninstall the existing File Protocols plug-in, NSS plug-in, and Storage Management plug-in before you upgrade to these new plug-ins.

For information about managing these services, see the following guides:

- *OES 2018 SP3: OES AFP for Linux Administration Guide*
- *OES 2018 SP3: OES CIFS for Linux Administration Guide*

Samba Management

Provides a Web interface for configuring your Samba server to provide file and print services to clients that support the Microsoft SMB and CIFS protocols. This plug-in supports CIFS access to files on NSS volumes, NCP volumes, and Linux POSIX volumes.

NSS Management

The OES Storage Services Management (`nssmgmt.npm`) plug-in allows you to manage NSS services (devices, software RAIDs, pools, and volumes). Information about using this plug-in is the focus of this guide.

Storage Management

The Storage Management (`storagemgmt.npm`) file contains common code that is shared by the storage-related plug-ins. If you use more than one of these storage-related plug-ins, you should install, update, or remove the `storagemgmt.npm` file and all installed storage-related `.npm` files at the same time.

IMPORTANT: If you remove any one of the installed storage-related plug-ins, it removes the common code (`storagemgmt.npm`) file, which breaks the remaining installed plug-ins.

Files for Storage-Related Plug-Ins

The module files (see Table 10-1, “Storage-Related Plug-Ins for iManager,” on page 94) are located in the `/var/opt/novell/iManager/nps/portal/modules/` directory.

The Java JAR files are located in the `/var/opt/novell/iManager/nps/WEB-INF/lib/` directory.

The Tomcat TLD files are located in the `/var/opt/novell/iManager/nps/WEB-INF/` directory.

Table 10-2 *Java and Tomcat Files for Storage-Related Plug-Ins*

Storage-Related Plug-In	Java Files	Tomcat Files
OES AFP	afpGadgets.jar afpManageLib.jar afpTags.jar	afp.tld
Archive and Version Services	arkGadgets.jar arkTags.jar arkManageLib.jar	ark.tld
OES CIFS	cifsGadgets.jar cifsManageLib.jar	cifs.tld
OES Cluster Services	ncsGadgets.jar ncsManageLib.jar ncs.jar ncsTags.jar	ncs.tld
OES Distributed File Services	dfsGadgets.jar dfsManageLib.jar nasGadgets.jar	dfs.tld
Files and Folders	fileman.jar	
OES Samba		samba.tld
OES Storage Services	nssGadgets.jar nssManageLib.jar	nss.tld
Storage Management (common to all)	nssAdminClient.jar nssGadgetLib.jar nssTags.jar	

10.1.2 Prerequisites for Using the Storage-Related Plug-Ins

The requirements in this section apply to the storage-related plug-ins for iManager that are described in "Understanding Storage-Related Plug-Ins" on page 94.

- "Web Browser Language Setting" on page 97
- "Web Browser Character Encoding Setting" on page 98
- "Protocols for iManager Communications" on page 98

Web Browser Language Setting

The iManager plug-in might not operate properly if the highest priority Language setting for your Web browser is set to a language other than one of iManager's supported languages. To avoid problems, in your Web browser, click **Tools > Options > Languages**, then set the first language preference in the list to a supported language.

Web Browser Character Encoding Setting

Supported language codes are Unicode (UTF-8) compliant. To avoid display problems, make sure the Character Encoding setting for the browser is set to Unicode (UTF-8) or ISO 8859-1 (Western, Western European, West European).

In a Mozilla browser, click **View > Character Encoding**, then select the supported character encoding setting.

In an Internet Explorer browser, click **View > Encoding**, then select the supported character encoding setting.

Protocols for iManager Communications

The storage-related plug-ins can be used to manage OES 2015 or later servers. Different communications protocols are required for connecting the various platforms.

Table 10-3 provides information about the protocols needed to use iManager to manage storage in a heterogeneous environment. A protocol annotated with an asterisk (*) is the default and is configured automatically on the servers. The protocols that you use must be loaded and running on both the iManager server and the target server that you want to manage.

For further clarification about WBEM, CIFS, and NCP, see the following section:

Table 10-3 *Interoperability of Protocols Used to Connect the iManager Server and Target Servers*

iManager Server Operating Platform	**Protocol Used to Connect to the Target Server Based on Its Operating Platform (* indicates the default)**			
	OES 1 Linux and Later	**OES 1 SP1 NetWare, NetWare 6.5 SP4, and Later**	**OES 1 NetWare and NetWare 6.5 SP3**	**NetWare 6.5 SP2**
OES 1 Linux and Later	WBEM	WBEM	WBEM (Start WBEM)	
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
OES 1 SP1 NetWare, NetWare 6.5 SP4, and Later	WBEM	WBEM	WBEM (Start WBEM)	
		NCP	NCP	NCP
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
OES 1 NetWare and NetWare 6.5 SP3	*WBEM	*WBEM	WBEM (Start WBEM)	
		NCP	NCP	NCP
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
NetWare 6.5 SP2	Not available	NCP	NCP	NCP

WBEM

Where WBEM is the default protocol, WBEM is loaded and runs automatically when you start the server. Otherwise, you must start WBEM to use the protocol.

The storage-related plug-ins for iManager require CIMOM connections for tasks that transmit sensitive information (such as a username and password) between iManager and the `_admin` volume on the OES server that you are managing. Typically, CIMOM is running, so this should be the normal condition when using the server. CIMOM connections use Secure HTTP (HTTPS) for transferring data, and this ensures that sensitive data is not exposed.

If CIMOM is not currently running when you click **OK** or **Finish** for the task that sends the sensitive information, you get an error message explaining that the connection is not secure and that CIMOM must be running before you can perform the task.

IMPORTANT: If you receive file protocol errors, it might be because WBEM is not running.

To check the status of SFCB:

1 As `root` in a console shell, enter

```
rcsfcb status
```

To start SFCB:

1 As `root` in a console shell, enter

```
rcsfcb start
```

10.1.3 Downloading and Installing Plug-In Updates

For information, see the iManager 3.2 website (https://www.netiq.com/documentation/imanager-32/).

10.1.4 Accessing iManager

1 Launch a Web browser.

2 Click **File > Open**, then enter

`https://`*`server-IP-address`*`/nps/iManager.html`

The URL is case sensitive. Replace *server-IP-address* with the actual server DNS name or IP address. For example:

`https://192.168.1.1/nps/iManager.html`

The iManager Login page opens.

3 Use your administrator username and password to log in to the eDirectory tree that contains the server you want to manage.

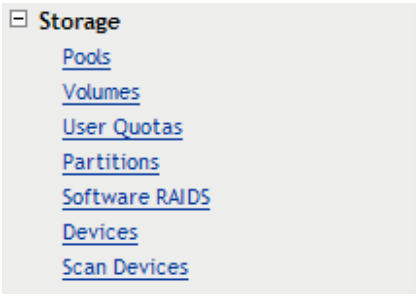
In iManager, you can access only the roles and tasks you are authorized to manage. For full access to all available iManager features, you must log in as Supervisor of the tree.

10.1.5 Accessing Roles and Tasks in iManager

1 Access iManager, then log in to the eDirectory tree where the server you want to manage resides.

For information, see Section 10.1.4, “Accessing iManager,” on page 99.

2 In **Roles and Tasks**, click the **Storage** role to expand its main tasks



As you work in the storage-related plug-ins, use the navigation links at the top of the page, referred to as “breadcrumbs,” to return to pages you recently visited, or use the links in **Roles and Tasks**. If you use the **Refresh** and **Back** features of your Web browser to navigate, iManager returns you to the initial page you encountered after login.

3 To activate the options on the selected page, select a server to manage.

For information, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

10.1.6 Selecting a Server to Manage

Before you can access the management options on a selected task page, you must select a server to manage that is in the same NetIQ eDirectory tree where you are currently logged in.

1 Use one of the following methods to select a server in the tree where you are logged in:

- Type the eDirectory distinguished server name for the server you want to manage, then press **Tab** or click somewhere on the page outside of the **Server** field to enter your selection. For example:

  ```
  svr1.company
  ```

- Click the **Search** icon to open the eDirectory Object Selector. Browse or search the list to locate the server you want to manage, then click the server name.
- Click the **Object History** icon to select a server you have recently managed.

2 Wait for iManager to retrieve information about that server and display the appropriate information to the task page you are in.

It might take several seconds to retrieve the information, depending on the size and complexity of your storage solution.

10.1.7 Storage Plug-In Quick Reference

The Storage role comprises seven key tasks:

- “Pools” on page 101
- “Volumes” on page 102
- “User Quotas” on page 103
- “Partitions” on page 104
- “Software RAIDs” on page 104
- “Devices” on page 105

Pools

You can create and manage storage pools to efficiently use all free space. You can also enable the Pool Snapshot feature to preserve point-in-time views of data pools and to support data backup and recovery. Snapshots are not supported for clustered pools.

Table 10-4 *Pool Management Tasks*

Task	Description	Reference
Pools	Displays a list of all pools on the selected server.	“Viewing Pools on a Server” on page 221
Details	Displays information about a selected pool.	“Viewing Pool Details” on page 221
New	Creates a new pool on the selected server.	“Creating a Pool” on page 212
Delete	Deletes a selected pool and all of its volumes and their data.	“Deleting a Pool” on page 220
Rename	Renames a selected pool.	“Renaming a Pool” on page 219
Activate	Mounts and activates a selected deactive or unmounted pool.	“Activating and Deactivating Pools” on page 217
Deactivate	Deactivates a selected active pool.	“Activating and Deactivating Pools” on page 217
Increase Size	Allows you to select one or more partitions from available devices in order to expand the size of a pool.	“Increasing the Size of a Pool” on page 218
Snapshot	Opens the Pool Snapshots page where you can create and manage pool snapshots. This option is disabled for online snapshot pools, because you cannot create a snapshot of a snapshot.	“Managing NSS Pool Snapshots” on page 243

Task	Description	Reference
Update eDirectory	Updates (replaces) the eDirectory object for a selected pool. Use only if a storage object is not recognized or has been lost.	"Updating eDirectory Pool Objects" on page 230
Deleted Volume	Displays a list of deleted volumes in a pool, and allows you to salvage or purge them. You can also pause and resume the autopurging of deleted volumes.	"Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool" on page 357
Offline	For a pool snapshot that is online as an active pool, takes it offline. This does not delete the pool snapshot.	"Viewing and Managing an Online Pool Snapshot" on page 257
Partitions	Displays a list of the partitions comprising the pool's storage space.	"Viewing Partition Information for a Pool" on page 223
Volumes	Lists all volumes on a selected pool.	"Viewing Volume Information for a Pool" on page 224
Devices	Displays a list of the devices that contribute space to a selected pool.	"Viewing Device Information for a Pool" on page 224

Volumes

You can create and manage NSS volumes, including their key attributes.

Table 10-5 *Volume Management Tasks*

Task	Description	Reference
Volumes	Displays a list of all volumes on the selected server.	"Managing NSS Volumes" on page 261
Details	Displays information about a selected volume.	"Viewing the Details of an NSS Volume" on page 272
New	Creates a new unencrypted volume. To create an encrypted NSS volume, use NSSMU.	"Creating Unencrypted NSS Volumes" on page 268
Delete	Deletes a selected volume and all of its contents.	"Deleting an NSS Volume" on page 288
Rename	Renames a selected volume.	"Renaming an NSS Volume" on page 279
Activate	Mounts and activates a deactive or unmounted volume.	"Activating and Deactivating an NSS Volume" on page 281
Deactivate	Deactivates an active volume.	"Activating and Deactivating an NSS Volume" on page 281

Task	Description	Reference
Mount	Mounts an unmounted volume. A volume must be mounted to view its details.	"Mounting and Dismounting an NSS Volume" on page 281
Dismount	Dismounts a mounted volume.	"Mounting and Dismounting an NSS Volume" on page 281
Move	Moves a selected NSS volume for the purpose of reorganizing and redistributing storage on the same server (or to other servers) in response to changing business needs.	For requirements, guidelines, and procedures for splitting volumes, see "Using DFS to Move NSS Volumes" in the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.
Split	Splits a selected NSS volume for the purpose of reorganizing and redistributing storage on the same server (or to other servers) in response to changing business needs.	For requirements, guidelines, and procedures for splitting volumes, see "Using DFS to Split NSS Volumes" in the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.
Properties	Displays a list of volume attributes, and allows you to set the attributes and name space to use for a volume. It also displays usage statistics for a volume.	"Viewing Properties of an NSS Volume" on page 272
User Quotas	Displays user quotas and space consumed for users of the volume. Administrators can view and manage user quotas. Users can view their own user space quotas.	"Configuring a User Space Quota" on page 347
Offline	Takes a selected snapshot volume offline, where it remains active in the background.	"Viewing and Managing an Online Pool Snapshot" on page 257
Update eDirectory	Updates (replaces) the eDirectory object. Use only if a storage object is not recognized or has been lost.	"Updating eDirectory Volume Objects" on page 271

User Quotas

The User Quotas task (see Table 10-6) allows managers to view and manage user space restrictions. It can be specified as an iManager role-based task for administrators. An individual user can log in to iManager under his or her own username to view the user's user space restrictions.

Table 10-6 User Quotas Task

Task	Description	Reference
User Quotas	For the Administrator user, displays quotas and allows the administrator user to manage user quotas for all users. For the user, displays the user's own space restrictions.	"Configuring a User Space Quota" on page 347

Partitions

NSS creates and deletes partitions for you when you work with software RAIDS and pools in iManager and NSSMU. To delete partitions manually, use the NSSMU Partitions page.

Table 10-7 Partitions Tasks

Task	Description	Reference
Partitions	Displays a list of all partitions on a selected server.	"Viewing a List of Partitions" on page 177
Details	Displays information about a selected partition.	"Viewing Details for a Partition" on page 179
Edit (NetWare)	Adds a label for a selected partition.	"Labeling a Partition" in the *NW 6.5 SP8: NSS File System Administration Guide*

Software RAIDs

You can create and manage software RAID 0, 1, and 5 devices to improve storage performance and reliability. You can use NSSMU to create a software RAID 0+1 or 5+1 device.

Table 10-8 Software RAID Management Tasks

Task	Description	Reference
Software RAIDs	Displays a list of software RAID devices on the selected server.	"Viewing a List of Software RAID Devices on a Server" on page 189
Details	Displays the details of a selected software RAID device.	"Viewing Details of a Software RAID Device" on page 190
New	Creates a new software RAID 0, 1, or 5 device for the selected server.	"Creating Software RAID Devices with iManager" on page 192
Rename	Renames a selected software RAID device.	"Renaming a Software RAID Device" on page 199

Task	Description	Reference
Increase Size	Expands an existing software RAID device by adding a partition to the RAID (up to the limit for that type of RAID). If there are no devices available, the button is disabled. Each partition you add must reside on a different device. You can add partitions that match the shared state of current member devices. They must be all local or all shared; you cannot mix them.	"Increasing the Size of a Software RAID Device" on page 200
Restripe	Completes a restriping process for a RAID 0 or RAID 5 device that has been paused.	"Restriping a Software RAID" on page 201
Delete	Deletes the selected software RAID device and removes the RAID relationship between member partitions and the underlying storage structures. All data on the member partitions is lost.	"Deleting a Software RAID Device" on page 205
Pools	Lists pools on a selected software RAID devices.	"Viewing Pools on a Software RAID Device" on page 205
Partitions	Lists details about partitions (member segments) in the RAID. In some cases, you can also delete a partition to repair a RAID.	"Viewing Partitions on a Software RAID Device" on page 206

Devices

You can configure, mount, and maintain a wide selection of storage devices, including direct-attached-storage devices, network-attached storage devices, networked storage devices in a Fibre Channel or iSCSI storage area network (SAN), and hardware device arrays.

Table 10-9 *Device Management Tasks*

Task	Description	Reference
Devices	Displays a list of all local and external devices available on the selected server.	"Viewing a List of Devices on a Server" on page 129
Details	Displays information about a selected device.	"Viewing Details for a Device" on page 130

Task	Description	Reference
Initialize Disk	Initializes a selected device by erasing its partition table, effectively destroying all of its data. If devices are present but not showing up for creating pools and volumes, you should initialize the disk.	"Initializing a Disk" on page 132
Multipath (NetWare)	For network configurations with multiple paths between network devices and your NetWare server, opens the Multipath page where you can set the primary path and path failover priorities for fault tolerance of connections between host bus adapters and storage devices. You can also bring paths up and down.	"Managing Multipath I/O to Devices (NetWare)" in the *NW 6.5 SP8: NSS File System Administration Guide*
Set Default Path (NetWare)	Sets the connection to selected device to its user-defined default primary path.	"Setting the Primary Path for a Device to Its Default Path" in the *NW 6.5 SP8: NSS File System Administration Guide*
Reset Registry (NetWare)	Resets the multipath priority settings for a selected device in the server registry to its user-defined defaults.	"Resetting the Server Registry with Default Priority Settings for a Device" in the *NW 6.5 SP8: NSS File System Administration Guide*
Shareable for Clustering	Enables device sharing to support high-availability server clusters.	"Sharing Devices" on page 133
Pools	Displays a list of the pools on a device.	"Viewing Pools on a Device" on page 135
Partitions	Displays information about partitions that are configured on a device.	"Viewing Partitions on a Device" on page 135

10.1.8 Files and Folders Plug-In Quick Reference

The Files and Folders plug-in for iManager provides the Files and Folders role for Linux and NetWare. It is also integrated in iManager as the **View Objects** option in the iManager toolbar. File browsing in iManager is available for file systems that have a Volume object defined in eDirectory, such as for NSS volumes on Linux and NetWare and for NCP volumes on Linux.

The Files and Folders Manager NPM file (`filemanager.npm`) is automatically installed in iManager. For information about manually installing NPM files for iManager, see the iManager 3.2 website (https://www.netiq.com/documentation/imanager-32/).

Click the **Files and Folders** role to select tasks first, then search for the file or folder you want to manage. Click the **View Objects** icon to view the Tree, Browse, and Search view of a server's eDirectory objects in the left pane. In the Tree view, click a Volume object to see the hierarchical file system tree view of the volume's folders and files. Click the plus (+) or minus (-) icon next to a directory name to expand or collapse the view of its subdirectories. Locate the file or folder you want to manage, then specify the action you want to perform for it.

The Files and Folders plug-in for iManager provides the tasks described in this section. All of the tasks and actions that are available under the **Files and Folders** role are also available from the **View Objects** tree view.

- "Delete" on page 107
- "Deleted Files" on page 107
- "Download" on page 107
- "New Folder" on page 107
- "Properties" on page 107
- "Upload" on page 108

Delete

Deletes a file or folder on an NSS volume or an NCP volume (NCP share on a Linux POSIX file system). For information, see Section 26.2, "Deleting a File or Folder on an NSS Volume," on page 376.

Deleted Files

Salvages or purges deleted files on an NSS volume. Salvage and purge of deleted files and directories is available only for NSS volumes where the volume's Salvage attribute is enabled. Other NSS settings determine how long deleted files and directories are available.

For information about configuring salvage and purge behavior for NSS volumes, see Chapter 24, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 351.

For non-NSS volumes, the Deleted Files report is empty (no deleted files).

Download

Downloads a selected file from an NSS volume or NCP volume to a specified location on your local drive or mapped network drive. For information, see Section 26.4, "Downloading Files from an NSS Volume," on page 378.

New Folder

Creates a folder on an NSS volume or NCP volume. For information, see Section 26.1, "Creating a Folder on an NSS Volume," on page 375.

Properties

Adds, removes, or modifies file system trustees, trustee rights, inherited rights filters, and file system attributes for files and folders on NSS volumes and NCP volumes. See Table 10-10 for a complete list of tasks you can perform from the Properties page.

Table 10-10 *Properties Tasks*

Properties Tab	Task Description
Information	Displays or modifies a directory quota for the selected folder. Directory quotas management is available only for NSS volumes where the volume's Directory Quotas attribute is enabled. For information, see Section 23.3, "Managing Directory Quotas," on page 340. Displays information about a selected file or folder, such as: ◆ Current size ◆ Time stamps for when the file was created, modified, accessed, and archived Displays or modifies the owner of a selected file or folder. Displays or modifies the file system attributes for a file or folder. For information, see Section 21.1.3, "Configuring File or Folder Attributes," on page 303.
Rights	Displays, adds, or removes file system trustees for a selected file or directory. Displays, grants, or revokes file system trustee rights for trustees of the selected file or directory. Displays or modifies the inherited rights filter for a selected file or directory. For information, see Section 21.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 301.
Inherited Rights	Displays or modifies the inherited rights filters at every level of the path for a selected file or directory. For information, see "Configuring the Inherited Rights Filter for a File or Directory" on page 307. Displays the effective rights for the selected file or directory. For information, see Section 21.1.5, "Viewing Effective Rights for a Trustee," on page 307.

Upload

Uploads a specified file from your local drive or a mapped network drive to a specified location on an NSS volume or NCP volume. For information, see Section 26.3, "Uploading Files to an NSS Volume," on page 377.

10.2 NSS Management Utility (NSSMU) Quick Reference

The OES Storage Services Management Utility (NSSMU) is a console-based utility for managing NSS storage media on a server. You can use NSSMU at any time as an alternative to the browser-based iManager Storage plug-in.

NSSMU is installed when you install NSS. The Linux install creates symlinks in the `/opt/novell/nss/sbin` folder for common NSS utilities, including NSSMU. Symlinks allow the path to NSSMU to become part of the `root` user's path, which allows you to run `nssmu` from a terminal console as the `root` user.

Table 10-11 identifies key functions available in NSSMU. This quick reference is also available in the `nssmu(8)` man page. To access the man page, enter the following at a terminal console prompt:

```
man 8 nssmu
```

Table 10-11 *Summary of Management Options in NSSMU*

Management Options	Description
Devices **F3 or I**= Initialize device (Do not initialize your system device.) **F5 or F**= Refresh display **F6, S or U** = Share (shareable/not shareable for clustering) **Space** = Select or unselect **Enter** = Show partitions **Esc or Q** = Previous menu	Use this option to initialize and maintain physical storage devices and software RAID devices available to this server. Use the Software RAID Devices option to create, repair, or delete RAIDs. Initialize the selected device by erasing its partition table, effectively destroying all of its data. If devices are present but not showing up for creating pools and volumes, you should initialize the disk. When you initialize a device, you can select the DOS or the GUID Partition Table (GPT) partitioning scheme for a given device. The DOS partitioning scheme supports devices up to 2 TB in size. It allows up to four partitions on a device. The GPT partitioning scheme supports device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size). It allows up to 128 partitions per disk. Each of its disks partitions is a logical device that is identified by a unique 128-bit (16-byte) GUID. **IMPORTANT:** It is recommended that you do not take a snapshot on a VMware ESXi, which includes both thick and thin-provisioned devices. If a snapshot is taken, all the thick-provisioned devices are randomly converted to thin-provisioned devices and vice versa.

Management Options	Description
Partitions **Ins or +** = Create an NSS partition (disabled) **Del or -** = Delete an NSS partition **F3** or M = Mirror partition (that contains an existing pool) **F5** or F = Refresh details of the partition **F6** or L= Label **Enter** =Show volumes **Esc or Q** = Previous menu	Use this option to display details about partitions. All types of partitions are displayed, including those for Linux file systems. The Create option is disabled. NSS partitions are automatically created for you as you define NSS pools or software RAIDs. You can delete a single partition at a time when repairing a failed software RAID partition. To delete all partitions for a software RAID, you should delete the RAID itself from the Software RAIDs page; otherwise, the RAID is not cleanly deleted. The Mirror option lets you specify 1 to 3 partitions to mirror an existing partition that contains an NSS pool. Effectively, you are creating a RAID1 mirror device for the pool. Each segment of the defined RAID is a complete mirror of the original pool and is the same size as the original partition. After you mirror the partition, manage the RAID from the Software RAIDs page. If you widen the NSSMU display screen, it widens the Partitions list panel and allows you to see the partitions' full names.

Management Options	Description
Pools **Ins or +** = Create a pool **Del** or - = Delete a pool **F3** or E = Expand a pool (by adding space) **F4** or U= Update NDS/eDirectory **F5** or F= Refresh the pool list **F6** or R = Rename a pool **F7, A or D** = Activate/deactivate a pool **S** = Display pool segments, segment size, and devices **j** = Join the cluster pool to the AD domain **g** = Media upgrade a pool to support AD users **F8 or N** = More (list more options) **F9 or V** = Show deleted volumes (then salvage, purge, or pause/resume autopurging) **M** = Move pool **Enter** = Show volumes for a pool **Esc or Q** = Previous menu **Space** = Refresh details of the selected pool **T** = Execute Fstrim on a pool	Use this option to create, delete, rename, and expand NSS storage pools to efficiently use all free space in the available devices. **NOTE** ◆ NSSMU supports only the creation of NSS64 pool type. NSS64 pools use 64-bit block addressing and supports up to 8 EB (exabyte). NSS64 pool type is by default Trustee Index media upgraded. ◆ While creating a pool, specify a unique name for the pool. ◆ Creating NSS64 pools or media upgrading an existing NSS32 pools to support AD users in a mixed-node cluster environment is not recommended, because the pools will not be accessible from nodes older than OES 2015. You can still go ahead and click 'y' (yes) to create NSS64 pools or media upgrade (AD media or Trustee Index media) an existing NSS32 pools. The recommended way to media upgrade an existing NSS32 pool is as follows: ◆ **For NSS32 Pools with AD Media Upgrade:** Configure preferred nodes for each media-upgraded cluster resource, so that these resources load on OES 2015 or later nodes. ◆ **For NSS32 Pools with Trustee Index Media Upgrade:** Configure preferred nodes for each media-upgraded cluster resource, so that these resources load on OES 2015 SP1 or later nodes. For more information on creating preferred nodes, see “Configuring Preferred Nodes and Node Failover Order for a Resource”in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*. After you create a pool, you can expand it by adding free space from the same or different device to increase its size. Select from the available free space to allocate it to the pool. Each device can contribute a different amount of space to the pool. Devices that allocate space must be of the same logical sector size and it must be in the same share state as the pool, that is, **Shared** or **Not Shared**. You can increase the size of a pool, but you cannot reduce it. You can also media upgrade the pool to support AD users, and this is a one-time activity that cannot be reverted.

Management Options	Description
	The join cluster pool option joins a cluster pool to the AD domain. When you join, you can choose to specify the container under which the pool object will be created or you could choose to use an existing pre-created object. You can choose to perform kinit before the launch of nssmu or during AD join process. kinit during the join process is valid for only one pool join as the kdestroy is performed for every join operation. For more information, see Section 10.2.1, “Joining Cluster Pools to the AD Domain,” on page 115. The move pool option moves an NSS pool from one location to another on the same system. The pool remains active during this process. All the segments in the pool are consolidated and moved to the specified device(s). If the specified device is larger than the original device, the pool is automatically expanded on the completion of move job. If a clustered pool is moved, on performing cluster resource migration the Move pool job is resumed on other node. In the cluster setup, the exact status of the pool move can be seen only on the node where the pool move job is in progress. For more information, see Section 16.13, “Moving a Pool,” on page 224. You can use the `fstrim` option to trim the unused blocks on the selected NSS pool. When you execute this option, the fstrim process runs in the background. Go to pool information page to view the fstrim state, last executed time, and last trimmed size on the selected pool. For more information on fstrim, see `/var/log/messages`. The `fstrim` option is supported only on thin-provisioned SCSi devices with the Vmware ESXi. **NOTE:** The `fstrim` option is not supported in the following cases: ◆ If the pool is created on the NSS software RAID device. ◆ If the NSS pool is created using both thin and thick storage devices. ◆ The NSS pool on which the snapshot is created.

Management Options	Description
Volumes **Ins or +** = Create a new volume **Del** or - = Delete a volume **F2** or P = Rename mount point for the volume (new path with volume name) **F3 or C** = View Compression Statistics **g** = AD-enable a volume **F4 or U** = Update NDS/eDirectory **F5 or F** = Refresh details of the volume **F6 or R** = Rename volume **F7, M or D** = Dismount/mount a volume. If it is encrypted, the volume prompts for a password on the first mount after a system boot or reboot. **F8 or N** = More (list more options) **F9 or S** = Name Space - choose Long (default), UNIX, DOS, or Macintosh **Enter** = View volume properties **Esc or Q** = Previous menu	Use this option to create, delete, rename, activate/deactivate, and mount/dismount NSS volumes and to set their attributes. You can also AD-enable a volume to support AD users. These volumes must be active and must be part of an AD media upgraded pool. AD-enabling a volume is a one-time activity and cannot be reverted. If the pool is AD media enabled and NSSMU validates the OES server that is currently joined to the AD domain, then "AD Enable the volume?" pop-up is displayed. If you click "Yes" the volume is AD-enabled. If the switch `/(No)EnableNewVolumeToAD` is enabled through `nsscon`, then this option takes preference. So even if you select "No" for the "AD Enable the volume?" pop-up, the volumes are AD-enabled. To store data in encrypted format, select the encryption key type, and then specify a password when you create the volume. This enables the Encryption attribute. The encryption setting persists for the life of the volume. The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128 or 256-bit NICI key based on the key type selected for encryption. On system reboot, specify the password when you activate the volume for the first time. **NOTE:** The AES256 encryption key type should be used only on the NSS64 pool type with the pool media upgraded to AES. You can mount encrypted volumes only from NSSMU on the first time after a system reboot. Provide the password when needed. Until you provide a password for encrypted volumes, you cannot mount multiple encrypted volumes at a time.
Linux Volumes **Ins** or + = Create **Del** or - = Delete **F3** or R = Rename **F5** or F = Refresh details of the Linux volumes **F7, M or D** = Mount or Dismount **Esc or Q** = Previous menu	Use this option to create and manage the Linux volumes. For more information, see "Managing Linux Volumes with NSSMU" in the *OES 2015 SP1: Linux POSIX Volume Administration Guide*.

Management Options	Description
RAID Devices **Ins or +** = Create a software RAID **Del or -** = Delete a software RAID device **F3 or E** = Expand a RAID device (add partitions) **F4, S or M** = Restripe (S) (to restripe or resume restriping for paused RAID 0 or RAID 5). Remirror (M) (to remirror or resume remirroring for paused RADI 1) **F5 or F** = Refresh details of the software RAID device **F6 or R** = Rename a RAID device **Enter** = Show segments (list member partitions for selected device) **Esc or Q** = Previous menu **F8 or N** = More (list more options) **Space** = Status Refresh	Use this option to create and manage NSS software RAID devices. A software RAID device emulates a hardware RAID device. RAID devices combine partitioned space on multiple physical devices into a single virtual device that you manage like any device. Each member device contributes an equal amount of space and only a single partition to the RAID. Pressing F6 would either restripe or remirror based on the chosen RAID device. **NOTE:** If the RAID 1 is already synchronized, pressing F6 will not show any remirroring progress.
Snapshot **Ins or +** = Create a pool snapshot **Del or -** = Delete a pool snapshot **F5 or F** = Refresh display **F7, M or D** = Mount or dismount the pool snapshot as an active pool. The snapshot functions continue whether the snapshot is mounted or dismounted. **Esc or Q** = Previous menu	Use this option to create, delete, mount, and dismount pool snapshots for NSS pools. Snapshots are stored on a separate partition that you specify, not another pool. After it is created, the partition for the snapshot pool cannot be expanded.

The default unit for setting and displaying the volume quota or pool size is Gigabyte (GB). However, the following units will also be displayed relative to the storage size:

Pool / Volume Quota Size	Displayed Unit
<= 1023 KB	KB
>= 1024 KB and <= 1023 MB	MB
>= 1024 MB and <= 1023 GB	GB
>= 1024 GB	TB

NOTE:

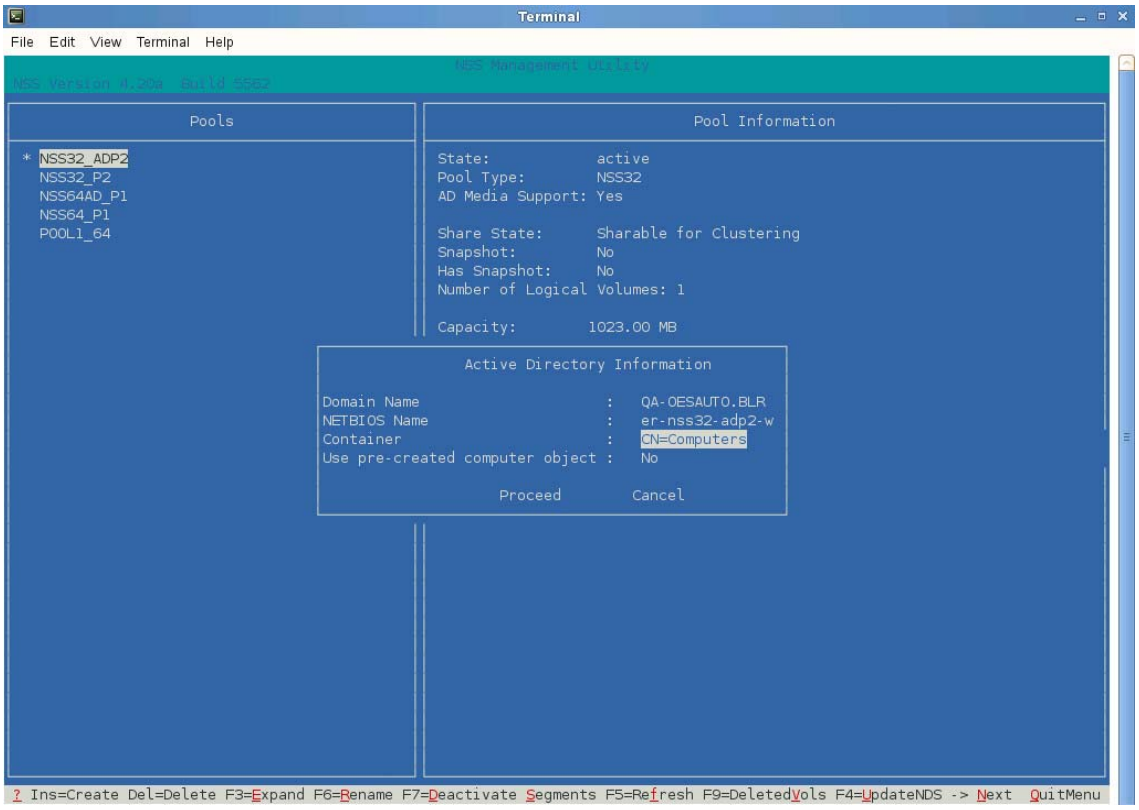
- The pool size is not displayed in KB as the minimum allowed pool size should be at least 12 MB.
- When the volume quota is entered without specifying any units, the volume quota size is assumed to be in GB. For example, specifying a value of 1 will be considered as 1 GB, 2 as 2 GB and 0.5 as 512 MB. Specifying the value of 'ALL' will create a pool consuming the entire disk space or LUN size.

10.2.1 Joining Cluster Pools to the AD Domain

This section describes the procedures to join cluster NSS resources to an AD domain so that they are accessible to AD users. Joining a cluster resource to the AD domain does not enable the pools and volumes for AD user access. NSS AD Media upgrade for pools and AD-enabling at volume must be done separately following the instructions at Section A.13.1, “NSS Media Upgrade Commands,” on page 452 and “Volume AD-enabling” on page 454.

You could also use the `novell-ad-util` CLI tool for the domain join. For more information, see “novell-ad-util Command Line Utility” in the *OES 2018 SP3: NSS AD Administration Guide*.

1. Ensure that your cluster node is joined to the AD domain. You should find an entry for the cluster node object created in the **Active Directory Users and Computers** screen of the AD server. Also ensure that the shared pool has at least one active volume for a successful domain join operation.
2. Launch NSSMU, select the shared pool that you want to join to the AD domain, then press **j**.



3. Specify the AD container where the computer object will be created. If you already have a pre-created computer object, select Yes, then specify the container where the pre-created computer object exist.
4. Select **Proceed**.
5. Perform kinit if not done already, then specify the appropriate AD user credentials for the domain join operation to complete. This user should have the following rights on the AD server: create computer objects, change password and reset password.
6. After a successful domain join operation, you should find your cluster pool computer object in the **Active Directory Users and Computers** screen of the AD server.

10.3 NSS Commands and Utilities

Command line instructions and utilities are available to control most NSS functions.

- Section 10.3.1, “Command Consoles,” on page 116
- Section 10.3.2, “NSS Commands,” on page 116
- Section 10.3.3, “NSS Utilities,” on page 117

10.3.1 Command Consoles

NSS commands and utilities are issued from command line interfaces that are referred to as consoles in this guide. All NSS commands and utilities are issued while logged in as the `root` user or a user with equivalent privileges.

- “Linux Terminal Console” on page 116
- “NSS Console” on page 116

Linux Terminal Console

NSS utilities for Linux are issued at the command prompt of a Linux terminal console.

If you are not running a graphical interface on the server, the terminal console is simply the command line prompt displayed when you log in to the server.

If you are using a graphical interface, you can open a terminal console by using one of these methods:

- Right-click on the Linux desktop, then select **Open Terminal** from the menu.
- From the Linux desktop, click the **Computer** menu, then select **Terminal (Command Line Terminal)** from the **Applications** menu.

NSS Console

The NSS Console (NSSCON, `nsscon(8)`) utility for Linux provides a command line interface in a console environment familiar to NetWare users. Use it to issue NSS commands and to monitor NSS activity through console messages. For more information, see Section B.4, “nsscon,” on page 493.

To start NSSCON, enter the following at a terminal console prompt:

```
nsscon
```

10.3.2 NSS Commands

To view a list of NSS commands and options, enter the following command at the NSSCON prompt:

```
nss /help
```

For information about NSS commands, see Appendix A, “NSS Commands,” on page 439.

10.3.3 NSS Utilities

The most well-known NSS utilities are the NSS Management Utility (`nssmu`) for managing storage and the NSS Console (`nsscon`) utility for issuing NSS commands. NSS provides other utilities to support more complex command line management tasks for NSS pools and volumes.

For information about NSS utilities, see Appendix B, “NSS Utilities,” on page 483.

10.4 OES NetStorage

OES NetStorage provides a Web-based interface to access directories and files on your NSS volumes on NetWare. You can also manage file system trustees, file system trustee rights, and directory and file attributes for the NSS file system on NetWare.

- Section 10.4.1, “Prerequisites,” on page 117
- Section 10.4.2, “Accessing NetStorage,” on page 117
- Section 10.4.3, “Configuring File System Trustees, Trustee Rights, and Attributes,” on page 118
- Section 10.4.4, “Purging and Salvaging Deleted Files,” on page 118
- Section 10.4.5, “Browsing Directories and Files,” on page 118
- Section 10.4.6, “Additional Information,” on page 118

10.4.1 Prerequisites

For NSS, users must be Linux-enabled with Linux User Management in order to use NetStorage. For information about installing and configuring Linux User Management and enabling users and groups for Linux, see the *OES 2018 SP3: Linux User Management Administration Guide*.

10.4.2 Accessing NetStorage

In iManager

From OES 2 onwards, NetStorage is accessible from within iManager.

1. Log in to iManager in the eDirectory tree of the servers that you want to manage.

   For information, see Section 10.1.4, “Accessing iManager,” on page 99.
2. In **Roles and Tasks**, select **NetStorage**.

Direct URL

To avoid conflicts, the date and time on the workstation being used to access NetStorage should be reasonably close (within a few hours) to the date and time on the server running NetStorage.

1. Launch your Web browser and open it to the following location:

   `http://192.168.1.1/oneNet/NetStorage`

   Replace *192.168.1.1* with the actual DNS name or IP address of your NetStorage server or the IP address for Apache-based services. If Apache-based services use a port other than 80, you must also specify that port number with the URL.

For example, if the port number is 51080, the URL would be in the form

`http://192.168.1.1:51080/oneNet/NetStorage`

2 Log in with your administrator username and password to manage file system access for directories and files on NSS volumes.

NetStorage uses NetIQ eDirectory for authentication. You can also log in as any username with equivalent rights to the administrator. This limitation does not apply if you have created a Storage Location object using SSH (Secure Shell).

10.4.3 Configuring File System Trustees, Trustee Rights, and Attributes

Using NetStorage, you can set file system trustees, trustee rights, and attributes for directories and files on NSS volumes on your Linux or NetWare servers by using the **NetWare Info** tab and **NetWare Rights** tab in the **Properties** dialog box.

IMPORTANT: The label of Netware refers to the NetWare Core Protocol (NCP) that is used for trustee management. Use the option for NSS volumes and NCP on Linux.

For information about file system trustees, trustee rights, and attributes for directories and files on NSS Volumes, see the *OES 2018: File Systems Management Guide*.

Directory or File Attributes

1 In NetStorage, select the file or directory, then click the **NetWare Info** tab to view or modify NSS directory or file attributes.

NSS File System Trustee Rights

1 In NetStorage, select the file or directory, then click the **NetWare Rights** tab to view or modify NSS file system trustee rights.

10.4.4 Purging and Salvaging Deleted Files

Using NetStorage, you can purge and possibly undelete (salvage) NSS files that were previously deleted. For information, see Section 24.6.1, “Using NetStorage,” on page 361.

10.4.5 Browsing Directories and Files

Administrators and users can use NetStorage to browse directories and files in an NSS volume.

10.4.6 Additional Information

For information, see:

- *OES 2018: File Systems Management Guide*
- *OES 2018 SP3: NetStorage Administration Guide for Linux*

10.5 OES Remote Manager

OES Remote Manager (NRM) is a browser-based management utility for monitoring server health, changing the configuration of your server, or performing diagnostic and debugging tasks.

NRM provides the NCP Server management plug-in that allows you to create shadow volumes using NSS volumes. You can also use it to manage NCP connections to the NSS volumes.

- Section 10.5.1, “Prerequisites for Using OES Remote Manager,” on page 119
- Section 10.5.2, “OES Remote Manager,” on page 120
- Section 10.5.3, “Accessing OES Remote Manager,” on page 120
- Section 10.5.4, “Starting, Stopping, or Restarting OES Remote Manager,” on page 121

10.5.1 Prerequisites for Using OES Remote Manager

- “Prerequisites for Remote Administration” on page 119
- “Prerequisites for Administrator User Access” on page 119

Prerequisites for Remote Administration

Your configuration must satisfy the following prerequisites:

- Make sure SSL 3.0 (where available) or SSL 2.0 is enabled in your Web browser.

  OES Remote Manager requires an SSL connection between your Web browser and the target server where it is running. You must enable SSL services for your Web browser; otherwise, the browser displays an error when it tries to display the OES Remote Manager Web pages.
- Ports 8008 (insecure) and 8009 (secure) are the default ports used for accessing OES Remote Manager. If you change the port number, make sure you specify the same value for the port number when you log in.

Prerequisites for Administrator User Access

You can log into OES Remote Manager as the `root` user or equivalent for the OES server you are managing.

You can alternately log in to OES Remote Manager with your eDirectory credentials if you first enable Linux User Management (LUM) in your eDirectory tree and install and configure LUM on the target server. The Administrator user or equivalent must be Linux-enabled and at least one of the following conditions must be met:

- The Administrator user (or equivalent user) must be associated to the eDirectory group that has the Supervisor right for the Entry Rights property for the UNIX Workstation object in eDirectory.
- The Administrator user (or equivalent user) must have the Supervisor right for the Entry Rights property to the NCP object that represents the Linux server in the eDirectory tree.

To see if a user is Linux-enabled, go to iManager, select the User role, then select the user to see if the following is true:

- The user has a **Linux Profile** tab on the Modify User page in iManager.
- The user's eDirectory object is associated with the UNIX Workstation object that represents the Linux server.

For information about configuring Linux User Management and enabling users for Linux, see the *OES 2018 SP3: Linux User Management Administration Guide*.

10.5.2 OES Remote Manager

OES Remote Manager allows you to browse NSS volumes. It requires that the NCP Server and NCP Server plug-in for OES Remote Manager be installed and running.

Tasks

The NCP Server plug-in supports the following tasks:

- Managing connections to NSS volumes and viewing open files for a connection.

  For information, see "Managing Connections for NCP Volumes and NSS Volumes" in the *OES 2018 SP3: NCP Server for Linux Administration Guide*.
- Creating or managing shadow volumes with NSS volumes as the primary and secondary storage areas.

  For information, see the *OES 2018 SP3: Dynamic Storage Technology Administration Guide*.

OES Remote Manager does not support the following tasks for NSS:

- Configuring directory quotas
- Salvaging and purging deleted files and directories
- Configuring file system trustees and attributes for directories and files
- Creating and managing partitions, pools, and volumes

Additional Information

For detailed information about OES Remote Manager, see the *OES 2018 SP3: OES Remote Manager Administration Guide*.

10.5.3 Accessing OES Remote Manager

1. From your Web browser, enter one of the following:

`http://server-ip-address:8008`

`https://server-ip-address:8009`

   Replace *server-ip-address* with the IP address of the server you want to manage. If you have Domain Name Services (DNS) installed on your network for server name-to-IP address resolution, you can optionally use the server's DNS name instead of the IP address.

2 Determine the authenticity of the SSL certificate, then accept it if the certificate is valid.

3 When the Login page appears, type the username and password of the `root` user for that server, or type the username and password of the Administrator user (or equivalent user) who is an eDirectory user and who has been Linux-enabled.

4 Click **OK** to log in to the target server and initiate your SSL session.

The management interface opens in your Web browser. After logging in, your SSL session for OES Remote Manager remains open until you close all your browser windows at that workstation.

10.5.4 Starting, Stopping, or Restarting OES Remote Manager

OES Remote Manager is installed and runs by default. If it hangs, you can use the `rcnovell-httpstkd status/start/stop/restart` or `systemctl status/start/stop/restart novell-httpstkd.service` to get status, start, to stop, or restart `httpstkd`. For the latest information about `httpstkd`, see "Starting or Stopping HTTPSTKD" in the *OES 2018 SP3: OES Remote Manager Administration Guide*.

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter the command for the task you need to perform:

Task	Command

Status	`rcnovell-httpstkd status`
	or
	`systemctl status novell-httpstkd.service`

Start	`rcnovell-httpstkd start`
	or
	`systemctl start novell-httpstkd.service`

Stop	`rcnovell-httpstkd stop`
	or
	`systemctl stop novell-httpstkd.service`

Restart	`rcnovell-httpstkd restart`
	or
	`systemctl restart novell-httpstkd.service`

10.6 Client for Open Enterprise Server

- Section 10.6.1, "Novell Client," on page 122
- Section 10.6.2, "Client for Open Enterprise Server for Windows," on page 122

10.6.1 Novell Client

The Novell Client software allows users of Linux workstations to access and use all of the services available on servers running NetIQ eDirectory. The Novell Client brings the full power, ease of use, manageability, and security of eDirectory to Linux workstations. The Novell Client for Linux fully supports NetWare, OES, and eDirectory services and utilities on a Linux workstation, including security, file, and print services through Novell iPrint.

For more information, see the Novell Client Linux Administration Guide (http://www.novell.com/documentation/linux_client/).

10.6.2 Client for Open Enterprise Server for Windows

In combination with NCP Server, the Client for Open Enterprise Server for Windows support the following:

- Management of file system trustees, trustee rights, and inherited rights filters for directories and files on NSS volumes
- Management of attributes for directories and files on NSS volumes
- Purge and salvage of deleted files on NSS volumes, if the volume is configured to support it by enabling the Salvage Files attribute for a volume
- Drive mapping for NSS volumes
- Login scripts for automatic drive mapping on login

For more information, see the Client for Open Enterprise Server Administration Guide.

10.7 Virtual File Services, APIs, and Scripts

Virtual File Services (VFS) provides methods that allow you to manage services such as NSS by using standard file system functions. Using VFS and a scripting or GUI-based interface, you can view the status and statistics for your system and change the system parameters.

NSS provides a special administration volume, known as the `_admin` volume, that exists on each server. This volume uses no disk space and is created at startup time. Using VFS and the services provided by files that are created on the `_admin` volume, you can potentially control all server management functions.

For more information and instructions, see *NDK: Virtual File Services* (https://www.microfocus.com/documentation/open-enterprise-server-developer-documentation/virtual-file-services/) in the Novell Developers Kit (NDK) documentation.

10.8 OES Linux Volume Manager (NLVM)

The OES Linux Volume Manager (NLVM) provides management of OES Storage Services (NSS) storage objects in Novell Open Enterprise Server (OES) 11 Support Pack 1 (SP2). The command line interface (CLI) commands can be used in a Linux console or in a script. The NSS management tools use the NLVM library of APIs to create and manage NSS storage objects. NLVM also provides options to create Linux POSIX file systems, such as BtrFS, Ext2, Ext3, ReiserFS, and XFS.

For more information, see the OES 2018 SP3: NLVM Reference.

11 Managing Devices

This section describes how to manage devices where you want to create or manage NSS storage objects.

- Section 11.1, “Understanding Devices,” on page 125
- Section 11.2, “Viewing a List of Devices on a Server,” on page 129
- Section 11.3, “Viewing Details for a Device,” on page 130
- Section 11.4, “Scanning for Devices,” on page 131
- Section 11.5, “Initializing a Disk,” on page 132
- Section 11.6, “Sharing Devices,” on page 133
- Section 11.7, “Viewing Partitions on a Device,” on page 135
- Section 11.8, “Viewing Pools on a Device,” on page 135
- Section 11.9, “Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers,” on page 136
- Section 11.10, “What’s Next,” on page 137

11.1 Understanding Devices

A block storage device is the physical, logical, or virtual storage media available to a server. A device can be directly attached to the server or connected via storage networking protocols such as Fibre Channel and iSCSI.

- Section 11.1.1, “Device Size,” on page 125
- Section 11.1.2, “Device Types,” on page 126
- Section 11.1.3, “Device Details,” on page 128

11.1.1 Device Size

NSS recognizes device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size).

NSS allows you to initialize devices to use either the DOS partition table format or the GPT (GUID Partition Table) format for a given device. When you create pools, you can combine space from devices that are formatted using any method.

The DOS partition table scheme supports devices up to 2TB in size. It allows up to four partitions on a device.

The GPT partition table scheme supports device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size). It allows up to 128 partitions per disk. Each of its disks partitions is a logical device that is identified by a unique 128-bit (16-byte) GUID.

IMPORTANT: Pools created on GPT initialized devices are not backward compatible with versions earlier to OES 11.

Different manufacturers report device sizes differently. The actual device size varies with the hardware design and the applications and software drivers that manage the device. Many vendors report sizes using a definition where 1 TB = 10E12 bytes = 1,000,000,000,000 bytes. Space can also be consumed by metadata that is added to manage the device. The location on the device where the metadata is stored can also vary by hardware manufacturer and software vendor. After you format the drive, yet another size might be reported. Third-party product documentation might state the maximum size limits of devices it supports before or after making accommodations for any management data or space lost to formatting. The size of devices you ultimately carve out for use with NSS depends on all these factors.

IMPORTANT: Make sure to refer to the documentation of the device manufacturer, application vendor, and software driver vendor for other limitations on the device size.

11.1.2 Device Types

The following are examples of common types of devices:

- "Server Disks" on page 126
- "Direct-Attached Storage Devices" on page 126
- "LUN Devices" on page 126
- "iSCSI Devices" on page 127
- "RAID Devices" on page 127
- "Multipath Devices" on page 128
- "Removable Media" on page 128
- "Virtual Disks" on page 128

Server Disks

Server disks include physical disks on the server or logical disks carved from the server disk.

Direct-Attached Storage Devices

Physical or logical disks can be directly attached to the server as individual devices or in a storage array.

LUN Devices

A LUN (logical unit number) can be either a physical or a logic disk drive. Refer to the iSCSI SAN or Fibre Channel SAN documentation for information about creating and managing LUNs for your SAN implementation.

A metaLUN is a controller-managed group of multiple LUNs or of multiple hardware RAIDs that are striped or concatenated together to be presented as a single LUN device to the server. Refer to the hardware manufacturer's documentation for information about creating metaLUNs.

iSCSI Devices

An iSCSI device is a remote target disk or tape drive on an iSCSI disk server that is made available across an IP network by iSCSI initiator software running on the server. After connecting to the disk server, you can view the devices in the **Devices** list and add NSS pools and volumes as you would with any device.

For information about managing and using iSCSI devices, see "Mass Storage over IP Networks—iSCSI" in the *SLES 12 SP2 Storage Administration Guide*. See also the Linux iSCSI Project.

RAID Devices

A RAID (redundant array of independent disks) is a logical device that combines space from multiple devices by using special hardware, software, or both. Data is striped or replicated across all member devices to improve data reliability, increase I/O performance, or provide device fault tolerance. All RAID types require configuration using a RAID management tool made for the specific hardware or software used in the RAID.

- "Hardware RAID Devices" on page 127
- "Controller RAID Devices" on page 127
- "Software RAID Devices" on page 127

Hardware RAID Devices

In a hardware RAID, the RAID functionality and management are in firmware within the storage cabinet. Refer to the hardware manufacturer's documentation for information about creating hardware RAIDs.

Controller RAID Devices

Controller RAID devices are also known as *BIOS RAIDs*, *fakeRAIDs*, *hostRAID*, and *quasi-hardware RAIDs.*

In controller RAIDs, the functionality and management are in the HBA or controller BIOS/firmware. If the controller does not contain an on-board CPU resource to use for RAID management, the controller RAID consumes server CPU resources to manage the RAID.

Refer to the hardware manufacturer's documentation for information about configuring Controller RAID devices. For information about using Controller RAIDs with OES, see *TID 3626577: BIOS RAID Support* in the Micro Focus Support Knowledgebase.

Software RAID Devices

Software RAIDs are controlled by special software in the server's OS such as in the HBA driver or in upper level module such as NSS. Software RAIDs consume CPU resources to manage the RAID.

For information about creating and managing NSS software RAIDs, see Chapter 14, "Managing NSS Software RAID Devices," on page 183.

You can optionally use Linux tools to create and manage Linux software RAIDs. Linux software RAIDs must be initialized with either a DOS or GPT partition format in order to be used by NSS.

Multipath Devices

If there are multiple connection paths between a device's hardware controller and the server, each path presents a given device to the server as a separate device. You must use a multipath management tool to resolve the multiple apparent devices to a single multipath device. Use the multipath device UUID or alias when you are creating NSS pools and volumes. Multipath tools also provide automatic path management for path failover, failback, and reconfiguration.

Use the Linux multipath I/O tools to create the multipath device.

Removable Media

Removable media devices include CDs, DVDs, or CD/DVD image files. Removable media are mounted as Linux POSIX file systems. Use Linux native tools to manage removable media.

Virtual Disks

In a Xen virtual environment, you use the Virtual Machine Manager in YaST to allocate storage devices from the host to the virtual machine. The devices that you want to use for the NSS file system on the guest machine must be less than 2 TB (where 1 TB = 2E40 bytes) if the guest operating is OES 2 SP3 or earlier versions. Devices of 2 TB or larger are supported from OES 11 onwards. For information about storage considerations in virtual environment, see Chapter 7, "Using NSS in a Virtualization Environment," on page 77.

11.1.3 Device Details

The following table describes the type of information available for each device by viewing the Device Details page.

Table 11-1 *Explanation of Device Details*

Device Detail	Description
Name	The device name assigned by the device manager.
Major Number Minor Number	The device identity in major:minor format. Major and minor numbers are associated with the device special files in the `/dev` directory and are used by the operating system to determine the actual driver and device to be accessed by the user-level request for the special device file.
Partitioning Type	DOS - The device has the DOS partitioning scheme. GPT - The device has the GPT partitioning scheme. LVM2 volume - The device has no partition table because there is an LVM volume at the beginning of the disk. This is the case when we create a Clustered Linux Volume. CSM - Unknown - The device is not recognized by NSS.

Device Detail	Description
Shareable for Clustering	The attribute of a device that indicates whether the selected device can be shared by multiple computers in a cluster solution.
Sector Size	The size of a logical sector in bytes.
Capacity	The total available storage space of the selected device.
Used Space	The amount of space on the device that is currently in use by partitions, including OES partitions for NSS as well as native Linux partitions.
Free Space	The total amount of space on the device that is currently not in use.
Pools	The drop-down list shows all pools that exist on this device. To view a pool's details or to manage a pool, select the pool from the list, then click the **View Details** icon to go to the **Pools** page for that pool.
Number of Pools	The total number of pools that use this device.
Partitions	The drop-down list shows all partitions that exist on this device. To view a partition's details, select the partition from the list, then click the **View Details** icon to go to the Partition Information page for that partition.
Mirror Status	For a RAID1 device, this field shows its status: ◆ **In Sync:** The mirror group is fully synchronized. ◆ **Partial Sync:** The mirror group is only partially synchronized. ◆ **Not Mirrored:** The device is not mirrored (only one partition).

11.2 Viewing a List of Devices on a Server

1. In iManager, click **Storage > Devices**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2. Select a server to manage.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

   Depending on the number of devices, it can take a few seconds to display the list of devices. Avoid clicking again in the page until it refreshes and displays the **Devices** list.

3 Select a device to view its details.

For an overview of the subtasks available from this page, see “Devices” on page 105.

11.3 Viewing Details for a Device

The **Details** field in the **Devices** page displays information about each device in the **Devices** list.

To view a device’s details:

1 In iManager, click **Storage > Devices**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

When the page refreshes the devices are listed in the **Devices** list. Depending on the number of devices, this can take several seconds. Wait for the page to load before moving to the next step.

3 Select a device in the **Devices** list to view its details.

The page must refresh to display the details, which might take several seconds.

11.4 Scanning for Devices

If you add more disks to the SAN, you can use the `rescan-scsi-bus.sh` script to scan for the new devices without rebooting. For information, see "Scanning for New Devices without Rebooting" (https://www.suse.com/documentation/sles-12/stor_admin/data/sec_multipath_best_practice.html) in the *SLES 12: Storage Administration Guide* (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).

You can also use the following procedure to scan the devices and make them available without rebooting the system:

1. On the storage subsystem, use the vendor's tools to allocate the devices and update its access control settings to allow the Linux system access to the new storage. Refer to the vendor's documentation for details.
2. On the Linux system, use the HBA driver commands to scan the SAN to discover the new devices. The exact commands depend on the driver.

   For example, for a QLogic 2300 HBA, the command is

   ```
   echo scsi-qlascan >/proc/scsi/qla2xxx/<host number>
   ```

   At this point, the newly added device is not known to the higher layers of the Linux kernel's SCSI subsystem and is not yet usable.
3. Scan all targets for a host to make its new device known to the middle layer of the Linux kernel's SCSI subsystem. At a terminal console prompt, enter

   ```
   echo "- - -" >/sys/class/scsi_host/host<hostnumber>/scan
   ```
4. If the devices have multiple paths, run the Multipath tool to recognize the devices for Device Mapper Multipath I/O (DM-MPIO) configuration. At a terminal console prompt, enter

   ```
   multipath
   ```

   For information about configuring multipathing for devices on your Linux server, see Managing Multipath I/O for Devices (https://www.suse.com/documentation/sles-12/stor_admin/data/cha_multipath.html) in the SLES 12: Storage Administration Guide (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).

11.4.1 Scanning for Devices using iManager

The system typically recognizes all devices on reboot or after you create them. If you add devices to a server and the system does not automatically detect them, you might need to scan for devices.

IMPORTANT: This feature is available only for servers of version OES 11 or later.

---

1. In iManager, click **Storage** > **Scan for Devices**.
2. Select a server to manage.

   The browser displays the **Scan Devices** page.

IMPORTANT: After iManager connects to the server, it scans for devices and displays them in the **Devices** list. The scan can take several seconds, depending on the number of adapters and disks on your systems. Click **Cancel** at any time to back out of the process.

3 View the list of devices.

NOTE: You can only view the list. There are no actions to make from this page.

11.5 Initializing a Disk

If you can see a device listed in the **Devices** list, but the device is not available for creating pools and volumes, you probably need to initialize the disk.

On the **Devices** page, the **Initialize Disk** option initializes the selected device and completely removes all the partitions it contains. All the data stored on the device is lost. If the device contains a partition of an NSS pool, a Traditional volume, or a software RAID device, the **Initialize** process also deletes data on all of the partitions of the entire pool, volume, or device, even if they reside on separate devices.

WARNING: Do not initialize the device that contains a system volume (such as `/boot`, `swap`, and `/(root)`). Initializing the system volume destroys the operating system and all the data in it.

This option is disabled (dimmed) if the selected device contains Software RAID 1 (mirrored) device.

It can also be disabled if there is no space available based on each partition's size, or if you already have the maximum number of partitions allocated in a software RAID device.

NOTE: You can also use *ncsinit* utility to initialize and to set the device to a shared state. For more information, refer Section B.15, "ncsinit," on page 514.

To initialize a disk from iManager:

1 In iManager, click **Storage > Devices**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage to view the **Devices** list.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

A list of devices appears in the **Devices** list.

3 In the **Devices** list, select the device that you want to initialize (such as `sdd`).

NOTE: You can select multiple devices for initialization.

4 Select MBR Type (Master Boot Record) from the following options:

- DOS: The DOS partition table scheme supports devices up to 2TB in size.
- GPT: The GPT partition table scheme supports device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size). It allows up to 128 partitions per disk. Each of its disks partitions is a logical device that is identified by a unique 128-bit (16-byte) GUID. Select the GPT option to create the device > 2 TB in size.

IMPORTANT: Pools created on GPT initialized devices are not backward compatible with versions earlier to OES 11.

5 Click **Initialize Disk**.

To initialize a disk from NSSMU:

1 In NSSMU, click **Devices**.

A list of devices appears in the **Devices** list.

2 In the **Devices** list, select a device.

NOTE: You can select multiple devices for initialization.

3 Press F3 to Initialize Disk.

4 Select **Partitioning Scheme** from the following options

- DOS: The DOS partition table scheme supports devices up to 2TB in size.
- GPT: The GPT partition table scheme supports device sizes up to 2E64 sectors (that is, up to 8388608 petabytes (PB) based on the 512-byte sector size). It allows up to 128 partitions per disk. Each of its disks partitions is a logical device that is identified by a unique 128-bit (16-byte) GUID. Select the GPT option to create the device of any size.

If you encounter any error, refer to the log messages at `/var/log/messages`. The messages are preceded with NSSMU.

11.6 Sharing Devices

Devices that are shared in a OES Cluster Services Cluster must be marked as shareable for clustering. This includes devices that you plan to use for shared software RAIDs, shared pools, and the cluster SBD (split-brain detector) partition. Unsharing a device fails if the device contains a pool (or any segment of a pool) that is cluster-enabled with OES Cluster Services.

- Section 11.6.1, “Understanding Sharing,” on page 133
- Section 11.6.2, “Planning for Device Sharing,” on page 134
- Section 11.6.3, “Configuring the Device’s Share State,” on page 134

11.6.1 Understanding Sharing

Storage devices that exist in a storage area network (SAN) can be shared by multiple servers in a cluster using OES Cluster Services. For information about clustering, see the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

IMPORTANT: The system hardware does not specify that disk drives come up automatically as **Shareable for Clustering** or **Not Shareable for Clustering**. You must manually set this value for each device, according to the configuration of your storage system.

Making a device shareable enables device sharing for those devices in high-availability clusters that you want to be part of a shared-disk storage solution. If the **Shareable for Clustering** option is enabled (selected), the selected storage device can be shared by multiple computers in a cluster.

WARNING: Marking a device as shareable for clustering sets all of the pools on this device to shareable. If any of these pools span multiple devices, you must make sure that each device is set to the same share state as this one, or the device can become unusable.

If a device is a member of a software RAID device, marking the device as shareable for clustering automatically sets all the other member devices of the RAID as shareable for clustering.

11.6.2 Planning for Device Sharing

By default, devices are not shared. Use the following guidelines when planning whether to share devices:

- The device that contains the operating system cannot be marked as **Shareable for Clustering**.
- You cannot mix space from shared and unshared devices to create a pool. If a pool spans multiple storage devices, all of the member devices in that pool must be marked as **Shareable for Clustering,** or all marked as **Not Shareable for Clustering**.
- You cannot mix space from shared and unshared devices to create a software RAID. All devices that contribute space to the RAID must be marked as **Shareable for Clustering**, or all marked as **Not Shareable for Clustering**.
- Do not mark a device as **Shareable for Clustering** if it is not capable of being shared, such as when the device contributes space to the system pool (`sys`), to an unshared software RAID, or to an unshared pool.

11.6.3 Configuring the Device's Share State

To configure the device's share state from iManager:

1. In iManager, click **Storage > Devices**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select the server that you want to manage to view a list of its devices.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.
3. In the **Devices** list, select a device to view information about it.
4. Depending on the current state of the device, do one of the following:
   - To set a device's share state to On, select the **Shareable for Clustering** check box, then click **Apply** or click **OK**.
   - To set a device's share state to Off, deselect the **Shareable for Clustering** check box, then click **Apply** or click **OK**.

   If you click **Apply**, iManager saves the change and remains on the device page. If you click **OK**, iManager saves the change and takes you to the main Storage page. If you do not click **Apply** or **OK**, the change is not implemented.

To configure the device's share state from NSSMU:

1. In NSSMU, click **Devices**.

   A list of devices appears in the **Devices** list.
2. In the **Devices** list, select a device. Press *F5* to select the device.

NOTE: You can select multiple devices at a time.

3 Press *F6* to share the device.

NOTE: If you have selected shared devices, you are prompted to make your shared devices unshared.

If you encounter any error, refer to the log messages at `/var/log/messages`. The messages are preceded with NSSMU.

11.7 Viewing Partitions on a Device

NSS abstracts all partition creation and deletion in iManager; there are no actions to perform on partitions. For information about partitions, see "Managing Partitions" on page 175.

1 In iManager, click **Storage > Devices**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

A list of devices appears in the **Devices** list.

3 In the **Devices** list, select a device.

4 In the **Details** area, click the arrow on the **Partitions** drop-down list to expand it.

5 Select a partition, then click **View Details**.

This opens the **Partitions** page. It displays a list of all the partitions that currently exist on the selected device.

6 To view details about a partition, select the check box next to it in the **Partitions** list, then click **Details** to view its details.

11.8 Viewing Pools on a Device

1 In iManager, click **Storage > Devices**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select the server that you want to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3 In the **Devices** list, select a device.

4 In the **Details** area, click the arrow on the **Pools** drop-down list to expand it.

5 Select a pool, then click **View Details**.

This opens the **Pools** page where you can view the details of the pool and manage it.

For information about pool management, see "Managing NSS Pools" on page 211.

11.9 Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers

Any journal based file system (including NSS) requires that when writes occur, they must be committed to disk in order to prevent corruption in event of a power failure.

Using write-back cache management can improve performance by allowing data to be held in cache rather than being written to disk. However, write-back cache management introduces the risk of losing data if the power fails. Many array controllers have an on-board battery backup, which can reduce the risk of data loss when using write-back, but it might not eliminate the risk. It is up to you to determine if the power backup is sufficient for power loss scenarios in your production environment.

If your system does not have sufficient power loss protection, we require using write-through cache management for SCSI devices to minimize the risk of losing data in the event of power failure. Write-Through cache management assures the file system that writes are being committed to disk as required.

If the server uses a RAID controller, enable Write-Through (disable Write-Back) cache management when configuring the RAID device by using the controller's BIOS setup routine or configuration utility.

To enable Write-Through cache management for local devices:

1. Log in to the server as `root`.
2. If the `scsi-config` utility is not already installed, install it using the `xscsi` RPM.

   The `xscsi` RPM, which contains the `scsi-config` command, is not installed by default.

   2a. In YaST, open the **Various Linux Tools** section.

   2b. Install the `xscsi` RPM package, then close YaST.

   The `xscsi` package installs the `scsi-config` utility in `/user/bin/scsi-config`.
3. Enable Write-Through (disable Write-Back) cache management for each SCSI device by performing the following for each device where you plan to use NSS volumes:

   3a. At a terminal console prompt, enter

   ```
   scsi-config
   ```

   3b. In the window that opens, browse to select drive you want to manage, then click **Continue**.

   3c. Click **Cache Control Page**.

   3d. Enable Write-Through cache management mode by deselecting the **Write cache enabled** check box.

   Write-Through cache management is enabled by default, so the **Write cache enabled** check box should be deselected. If the **Write cache enabled** check box is selected, Write-Back cache management mode is enabled and you deselect the box to disable Write-Back cache management.

   3e. Click **Quit > Save Changes**.

   3f. When prompted to confirm the change, click **Go Ahead and Save > Quit.**

   3g. To verify the setting, at a terminal console prompt, enter

   ```
   scsiinfo -c /dev/sdx
   ```

Replace /dev/sdx with the device you are checking.

A value of 0 for **Write Cache** means that the drive is in Write-Through cache management mode.

11.10 What's Next

If your server provides multiple I/O paths between the server and its storage devices, configure the primary path and path priorities for I/O failover for each device. For information, see Chapter 15, "Managing Multipath I/O to Devices," on page 209. When you are done, continue with creating software RAIDs and pools.

To configure software RAID devices, see Chapter 14, "Managing NSS Software RAID Devices," on page 183.

To create pools of storage on the devices, see Chapter 16, "Managing NSS Pools," on page 211.

12 Migrating NSS Devices to OES 2018 SP2

This section describes the steps involved in migrating OES Storage Services devices to Open Enterprise Server 2018 SP2 servers.

IMPORTANT: For a general discussion of migration issues in OES 2018 SP2, see "Migrating Existing Servers and Data" in the *OES 2018 SP3: Planning and Implementation Guide*.

- Section 12.1, "Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2018 SP2," on page 139
- Section 12.2, "Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2018 SP2," on page 140
- Section 12.3, "Moving Clustered Devices with NSS Volumes to OES 2018 SP2," on page 145
- Section 12.4, "Migrating NSS Data from NSS32 to NSS64," on page 145

12.1 Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2018 SP2

You can move devices containing NSS volumes between NetWare 6.5 SP8 servers and OES 2018 SP2 servers. When you move an unshared device to a different server, you must decommission its volumes in eDirectory for the current server, then recommission them for the new server.

For shared NSS pools and volumes, OES Cluster Services provides this service automatically during a rolling cluster conversion from NetWare 6.5 SP8 to OES 2018 SP2. For information about converting shared pool cluster resources and service resources, see the *OES 2015 SP1: Novell Cluster Services NetWare to Linux Conversion Guide*.

- Section 12.1.1, "Media Format," on page 139
- Section 12.1.2, "Pool Snapshots," on page 140
- Section 12.1.3, "Cross-Platform Issues," on page 140

12.1.1 Media Format

The NSS media upgrade for enhanced hard links support is available for the following operating platforms:

- NetWare 6.5 SP4 and later
- Novell Open Enterprise Server 1 Linux and later

The media upgrade is not available on OES 1 Linux, NetWare 6.5 SP3, and earlier versions. You cannot move a device that has been upgraded to the new media format to a platform that does not support it. For information about the media format upgrade, see Chapter 5, "Upgrading the NSS Media Format," on page 51.

12.1.2 Pool Snapshots

Different pool snapshot technologies are used for NSS pools on NetWare and NSS pools on Linux. You can create pool snapshots on either platform, but the snapshots are unusable if you move the devices cross-platform and are invalid if you move the volume back.

WARNING: Before moving a device cross-platform make sure to delete any existing pool snapshots for all pools on it. You might not be able to see the original pools on the Linux platform if you do not delete the snapshots before moving the device.

12.1.3 Cross-Platform Issues

For information about differences to expect when using NSS, see Chapter 8, “Cross-Platform Issues for NSS,” on page 85.

12.2 Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2018 SP2

This section describes how to move devices cross-platform from a NetWare 6.5 SP8 server to OES 2018 SP2 server. NSS supports moves of devices containing NSS volumes between any servers that support a compatible media format. For information, see Section 12.1, “Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2018 SP2,” on page 139.

IMPORTANT: Similar handling is necessary when moving devices with NSS pools between any two OES servers (NetWare to Linux, NetWare to NetWare, or Linux to Linux).

To preserve the NSS pool and volumes on the device when you move it, you must modify the volumes’ Storage objects in eDirectory. You decommission the volume by removing its related Storage object from eDirectory for the original server. You recommission the volume by creating a new Storage object in eDirectory for the destination server. When moving clustered devices cross-platform for a cluster conversion from NetWare to OES, OES Cluster Services automatically manages the Storage object updates to eDirectory.

NOTE: The *decommission* and *recommission* terminology is used only to illustrate the process; it does not represent a particular technology or tool.

- Section 12.2.1, “Prerequisites,” on page 141
- Section 12.2.2, “Setting Up File Access For Users on the OES Server,” on page 141
- Section 12.2.3, “Decommissioning Each NSS Pool and Its Volumes on the Original Server,” on page 142
- Section 12.2.4, “Recommissioning Each NSS Pool and Its Volumes on the Destination Server,” on page 143
- Section 12.2.5, “Using Scripts to Decommission and Recommission NSS Volumes,” on page 144

12.2.1 Prerequisites

The prerequisites in this section apply to moving multiple devices from a NetWare 6.5 SP8 server to an OES 2018 SP2 server.

IMPORTANT: When moving a non-clustered device, you must also move any other devices that contribute segments to the NSS pools on the device you are moving.

Compatibility Issues for Using NSS Volumes Cross-Platform

Before you begin, make sure you understand the Section 8.2, “Cross-Platform Issues for NSS Volumes,” on page 85.

Original NetWare Server

You can move NetWare 6.5 SP4 (or later) NSS media to an OES 2018 SP2 server if the operating platform can support the NSS media format. NetWare 6.5 SP3, OES 1 SP2 Linux, and earlier servers do not support the new media format.

For information, see Section 5.1, “Guidelines for Upgrading the Media Format of NSS Volumes,” on page 51.

Destination OES 2018 SP2 Server

- NSS and other needed services must be installed on the OES 2018 SP2 server where you want to move the NSS volume. For information, see Section 4.2, “Installing and Configuring NSS,” on page 44.

12.2.2 Setting Up File Access For Users on the OES Server

Before or after you move an NSS volume from NetWare to Linux, you need to set up file access for users on the OES server.

Set Up Users in eDirectory

The original server and the destination server can be in the same or different eDirectory trees.

If the destination server is in the same tree as the original server, the file system trustees and trustee rights continue to work after the move.

If the destination server is in a different tree, use eDirectory to enable or reassign affected users for access in the destination tree. For information, see the eDirectory website (https://www.netiq.com/documentation/edir88/).

Set Up Protocols and Services

To provide access for users on the OES server, do one or more of the following depending on your network environment:

- **NCP Server and Services:** Install and configure NCP Server to allow the users to access the volume with the Client for Open Enterprise Server or other NCP services. For information, see the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

- **OES AFP:** Install and configure OES AFP to allow the users to access the volume with the Apple Filing Protocol. For information, see the *OES 2018 SP3: OES AFP for Linux Administration Guide*.
- **OES CIFS:** Install and configure OES CIFS to allow the users to access the volume with CIFS. For information, see the *OES 2018 SP3: OES CIFS for Linux Administration Guide*.
- **Linux Protocols and Services:** Install and configure other protocols, such as Linux NFS to allow the users to access the volume with the non-NCP protocols. Using these Linux services requires that the users be Linux enabled to execute Linux commands and services on the volume.

  For information about configuring Linux NFSv3, see Section 19.16, “Exporting and Importing NSS Volumes for NFS Access,” on page 282.

  For information about enabling users and the Linux service with Linux User Management (LUM), see the *OES 2018 SP3: Linux User Management Administration Guide*.

For guidelines about users and access, see Section 6.5, “Access Control for NSS,” on page 68.

12.2.3 Decommissioning Each NSS Pool and Its Volumes on the Original Server

For each NSS pool, decommission the pool and its volumes from the original server.

1. If you use native Linux protocols or Linux services (such as SSH and FTP) for user access on the destination OES 2018 SP2 server, you must Linux-enable the current users of the volumes before you move the devices.

   IMPORTANT: If you do not use native Linux protocols or services for user access, this step is not necessary.

   Use one of the following methods to Linux-enable users of the volumes on the device:

   - To enable multiple users at once, use the `nambulkadd` command.

     User IDs are automatically refreshed after the enabling process ends.
   - To enable a single user at a time, use iManager.

   For information, see the *OES 2018 SP3: Linux User Management Administration Guide*.
2. Deactivate the pool on the device.
   - **2a** In iManager, click **Roles and Tasks**.
   - **2b** Click **Storage > Pools**.
   - **2c** Browse to select the original server where the NSS pool resides.
   - **2d** Select the pool you want to decommission, then click **Deactivate**.
3. Remove the eDirectory Storage objects for the NSS pool and each of its volumes.
   - **3a** In iManager, click **Roles and Tasks**.
   - **3b** Click **eDirectory Administration > Delete Object**.
   - **3c** Specify the name and context of the object or objects you want to delete.
   - **3d** Click **OK**.
4. Repeat Step 2 and Step 3 for each pool on the devices you plan to move.
5. If you are using DFS in the tree where the original server is located, run the `vldb repair` command.

On the primary VLDB server, at the command prompt, enter

```
vldb repair
```

This removes a GUID entry from the VLDB for each of the decommissioned volumes.

6 Remove or reallocate the devices from the original server. Depending on your storage configuration, this might require a server shutdown.

12.2.4 Recommissioning Each NSS Pool and Its Volumes on the Destination Server

For each NSS pool, recommission the pool and its volumes on the destination server.

1 Relocate or reassign the devices to the destination server.

2 Reboot the destination server to mount the devices.

3 If a pool on the devices you moved is not automatically activated, activate the pool.

3a In iManager, click **Roles and Tasks** .

3b Click **Storage > Pools**.

3c Browse to select the destination server.

3d Select the pool, then click **Activate**.

4 Create the eDirectory Storage objects for the NSS pool and each of its volumes.

4a In iManager, click **Roles and Tasks** .

4b Click **Storage > Pools**.

4c Browse to select the destination server.

4d Select the pool, then click **Update eDirectory**.

4e In the lower right, select **View Volume Details** to view all volumes on the selected pool.

iManager opens to the Volumes page with the server and pool preselected.

4f For each volume in the selected pool, select the volume, then click **Update eDirectory**.

4g Repeat Step 4d through Step 4f for each NSS pool and its volumes.

5 Allow the eDirectory tree to stabilize.

This can take several minutes.

6 Run the `vldb repair` command.

At the server command prompt on the primary VLDB server, enter

```
vldb repair
```

This adds a GUID entry to the VLDB for each of the recommissioned volumes.

12.2.5 Using Scripts to Decommission and Recommission NSS Volumes

Scripts are available to automate the process of decommissioning and recommissioning NSS volumes that are not cluster-enabled, see Decommissioning Script and Recommissioning Script for moving NSS devices cross-platform (http://www.novell.com/documentation/oes/script/decom_recom.zip). This `decom_recom.zip` file contains two Perl scripts:

- **decom.pl:** The decommissioning script deactivates the specified pool, removes eDirectory Storage objects for a specified NSS pool and each of its volumes on the original server, then it repairs the VLDB, if it exists, to remove the volumes' information from the VLDB. You provide the pool name, and the script automatically gets the list of volumes on the pool.
- **recom.pl:** The recommissioning script activates the specified pool, creates eDirectory Storage objects for a specified NSS pool and each of its volumes on the destination server, then it repairs the VLDB, if it exists, to add the volumes' information to the VLDB. You provide the pool name, and the script automatically gets the list of volumes on the pool.

The scripts support moving NSS volumes on NetWare 6.5 SP8 to OES 2018 SP2. You can modify the scripts to move volumes between any two non-clustered OES servers:

- NetWare to Linux
- Linux to NetWare
- NetWare to NetWare
- Linux to Linux

Decommissioning NSS Pools on the Original Server with decom.pl

For each NSS pool, decommission the pool and its volumes from the original server.

1. If you use non-NCP protocols or Linux services for user access on the destination OES 2018 SP2 server, you must Linux-enable the current users of the volumes before you move the devices.

   IMPORTANT: If you use only NCP Server and NCP services for user access, this step is not necessary.

   Use one of the following methods to Linux-enable users of the volumes on the device:

   - To enable multiple users at once, use the `nambulkadd` command.

     User IDs are automatically refreshed after the enabling process ends.

   - To enable a single user at a time, use iManager.

   For information, see the *OES 2018 SP3: Linux User Management Administration Guide*.

2. For each NSS pool on the device you are moving, run the `decom.pl` script and specify the name of the pool to decommission.
3. Remove or reallocate the devices from the original server. Depending on your storage configuration, this might require a server shutdown.

Recommissioning NSS Pools on the Destination Server with recom.pl

For each NSS pool, recommission the pool and its volumes on the destination server.

1. Relocate or reassign the devices to the destination server.
2. Reboot the destination server to mount the devices.
3. For each NSS pool on the device you moved, run the `recom.pl` script and specify the name of the pool to recommission.

12.3 Moving Clustered Devices with NSS Volumes to OES 2018 SP2

For information about converting clusters from NetWare 6.5 SP8 to OES 2018 SP2, see the *OES 2015 SP1: Novell Cluster Services NetWare to Linux Conversion Guide*.

12.4 Migrating NSS Data from NSS32 to NSS64

Using Data Migration, you can move the NSS data from NSS32 to NSS64 pools or volumes. The data migration is performed by migrating all the data and corresponding metadata from the source NSS32 to target NSS64 pools or volumes. This section covers data migration from NSS32 to NSS64 pools or volumes in the same tree, same server or different server, and clustered or non-clustered pools or volumes.

- Section 12.4.1, “Data Migration Use Case,” on page 145
- Section 12.4.2, “Preparing for Data Migration,” on page 145
- Section 12.4.3, “Migrating Data Using Migration Tool,” on page 146
- Section 12.4.4, “Migrating Data Using migfiles Utility,” on page 160
- Section 12.4.5, “Migrating Data Using Distributed File Services (DFS),” on page 165
- Section 12.4.6, “Migrating Data Using Dynamic Storage Technology (DST),” on page 166
- Section 12.4.7, “Migrating Data Using rsync Utility,” on page 169

12.4.1 Data Migration Use Case

- The data size is growing rapidly and the storage support provided by NSS32 (8 TB) pool is not sufficient. Therefore, NSS32 pool can be replaced with NSS64 (8 EB) pool to store large amount of data.
- Multiple NSS32 pools can be consolidated to a single NSS64 pool due to large storage support.

12.4.2 Preparing for Data Migration

- Ensure the source and target volume is in the same tree.
- To handle the compressed files, see Migrating Compressed Files in the OES 2018 SP3: Migration Tool Administration Guide.

- If source or target volume is DST enabled, see Data Migration for DST Volumes in the OES 2018 SP3: Migration Tool Administration Guide.
- Ensure that the source and target volume properties are same. You can obtain the pool and volume information using Section B.12, “nsssettings,” on page 511.
- If source volume is accessible by the end user during migration, ensure that the final sync (remove files from the target that no longer exist on the source, files that are renamed, or moved to a different folder) is performed before decommissioning the source volume.
- Ensure to take backup of the data, although the data on the source server is not deleted as part of migration.
- To retain any deleted files on the volume, salvage those files before migration.
- Ensure that you allocate sufficient space for the target volume to hold all the source data.

12.4.3 Migrating Data Using Migration Tool

This section provides information on how to use the Migration tool to migrate the data from NSS32 source to NSS64 target volume. For more information about Migration tool, see Overview of the Migration GUI, Using the Migration GUI Tool, and Security Considerations for Data Migration sections in the OES 2018 SP3: Migration Tool Administration Guide.

The migration can be done in the following ways:

- “Migrating to a Newly Created NSS64 Volume” on page 146
- “Migrating to an Existing NSS64 Volume” on page 151

Migrating to a Newly Created NSS64 Volume

- “Data Migration” on page 146
- “Data Synchronization” on page 151
- “Log Information” on page 151

Data Migration

1. Create a new NSS64 pool and volume on the server or create a new volume on the existing NSS64 pool. For more information, see Section 16.2, “Creating a Pool,” on page 212 and Section 19.3, “Creating Unencrypted NSS Volumes,” on page 268.
2. Launch the Migration Tool from the target server, using either of the following methods:

   Desktop: Click **Computer > More Applications > System > Novell Migration Tools** to launch the Migration GUI.

   Server Console: Log in as the root user and at a server console, enter `miggui`.

   NOTE: If you are using putty, ensure that X forwarding is configured.
3. Enter authentication credentials for the source server.

(Optional) Is Cluster Resource: If you want to migrate data in a cluster environment, you can perform either of the following:

- **Migrating Cluster Volumes:** In the **Source Server Authentication** screen, specify the cluster resource IP and select the **Is Cluster Resource** option. On configuring file system the Volume Information tab displays all cluster volumes from the cluster resource as part of the source volume.
- **Migrating Non Cluster Volumes from a Cluster Node:** In the **Source Server Authentication** screen, specify the cluster node IP and do not select the **Is Cluster Resource** option. On configuring file system the Volume Information tab displays all non cluster volumes present on the source server.

4 Enter the authentication credentials for the target server.

5 In the **Services** panel, click **Add** and select **File System**.

The **Status** of the file system service is **Not Configured**.

6 To configure migration parameters for the file system, select **File System**, then click **Configure**.

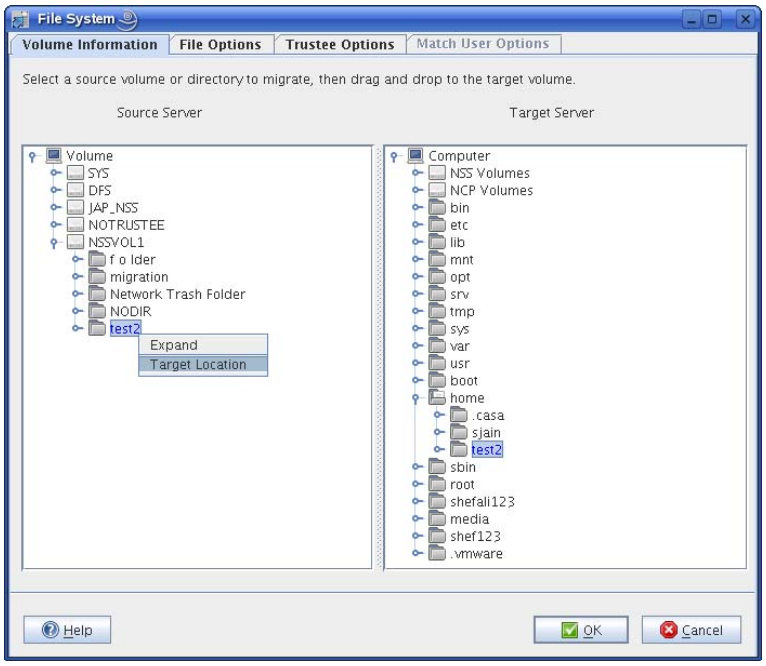
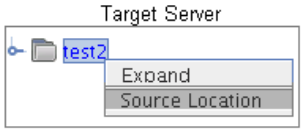
Tabs	Purpose
Volume Information	Identify the volumes or folders that you want to move from the selected source server to a selected target server. By default, all of the data in the volumes or folders that you select for migration in the source server tree is migrated to the target server.
File Options	Customize the files and quotas that are migrating to the target server. You can also specify the home directory location and set options to synchronize the file system.

7 In the **Volume Information** tab, in the **Source Server** tree, select volumes or folders that you want to migrate, then drag and drop it in the **Target Server** tree. The names of the source cluster volumes can only include "_" as a special character to be listed in the **Source Server** tree.

IMPORTANT: A DFS junction is displayed under the source tree as a folder because this junction appears in the file structure as a directory. Under **Volume Information**, the DFS junction can be dragged to the target server tree, but actually, the junction and the data are not migrated to the target server and migration fails. However, if you select the source volume that contains the junction for migration and dragged to the target server tree, the junction is migrated to the target server.

In the **Source Server** tree, you cannot expand volumes or folders that are copied to the **Target Server** tree.

For explanation on different tasks that can be performed in the Volume Information tab, refer to the table below, else proceed with default settings to Step 8.

Task	Description
Target Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved to the target server. In the **Source Server** tree, right-click the volume or folder that is selected for migration, then click **Target Location** from the drop-down menu. The tree in the **Target Server** view expands to display the volume or folder that was copied from the source server. 
Source Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved from the source Server. In the **Target Server** tree, right-click the volume or folder that is highlighted for migration, then click **Source Location** from the drop-down menu. The tree in the **Source Server** view expands to display the volume or folder that was copied to the **Target Server**. 
Volumes or Folders selected for migration	The volumes or folders that are selected for migration are highlighted in blue in the Source Server tree and the Target Server tree.
Removing Volumes or Folders from the Target Server	In the target server tree, right-click the volume or folder that you have decided not to migrate, then select **Undo**. The folder no longer appears under the target server tree and is no longer a candidate for migration.

Task	Description
Follow Cluster Resource	Select this option to perform uninterrupted migration when cluster resources migrate to different cluster nodes. This option is valid only on the source server clusters. For example, when a failure occurs on one node of the cluster, the resources are relocated to another node in the cluster. The migration tool connects to the cluster instead of individual server and performs uninterrupted migration during this failure. If this option is not selected, migration stops when the resource migrates to a different node. When the resource comes up on a different node, run the migration project again, the migration tool ensures that the migration process resumes from the state where it had stopped. On migrating data to cluster volume on the target server, migration stops when the resource migrates to a different node. To continue migration you must make the resource active on the target server.

8 Click the **File Options** tab, then click **OK** to accept the defaults.

or

Use the options to customize the files and quotas to migrate to the target server, then click **OK** to save the settings.

For explanation of the different tasks that can be performed in the File Options page, refer to the Table below.

Task	Description
Duplicate File Resolution	Determines what action to take when a file copied from the source server has the same filename as an existing file on the target server. Specify one of the following resolutions: ◆ **Always Copy Source File (default):** The migrated file always overwrites the existing file. ◆ **Never Overwrite Existing File:** The file from the source server is not migrated, if a file of the same name exists on the target server. ◆ **Copy if Newer:** The migrated file overwrites the existing file on the target server, only if its last modified date is newer than the existing file's date. This option is applicable only for data migration.
Quotas	This option is applicable only for data migration. **NOTE:** If you are migrating to a different file system (NSS to NCP volumes or from NSS to Linux POSIX volumes) on the target server, user quotas and directory quotas are not valid. ◆ **Exclude User Quotas on Source:** The user quotas from the source server are not copied to the target server. ◆ **Exclude Directory Quotas on Source:** The directory quotas from the source server are not copied to the target server. ◆ **Disable Quota Checks on Target:** The user and directory quotas set on the target server are ignored by the migration tool on performing data copy.

Task	Description
File Filters	Determines which files to include for migration. If no filters are set, all files are migrated. You can specify the files that you want to migrate by specifying the date range or you can exclude the files from migrating by specifying the filenames or file extensions. ◆ **Last Accessed/ Last Modified:** The date range to include files for migration. ◆ **Exclude File(s):** The filenames or file extensions to exclude from migration. Wildcards (*) are permitted. For example: `*.mp3`, `*.mov`, `*.tmp`, `samplefile.txt`, "`my sample file.txt`." Specifying `*.mp3` excludes all files with an extension of `.mp3` from being migrated. Specifying `samplefile.txt` excludes all samplefile.txt from being migrated.
Home Directory Options	Specify the target server path for the users whose home directory you are migrating from the source server. For example, If the users's home directory path on the source server is `/media/nss/VOL1/users` and the target path where the users will be migrated is `/media/nss/VOL2/users`, then specify the path in the Home Directory Options as `/media/nss/VOL2/users`. On successful migration, the home directory of the users is updated with the new target server path. **NOTE:** If you are performing migration across multiple volumes, you cannot specify multiple home directory paths.
Sync Options	The **Sync** option performs synchronization of the target server with the source server. After completion of file system migration, if the source server is updated with new information, you can use the **Sync** option for synchronizing the servers. The **Sync** option is available in the main Migration GUI window. **Delete Files Not On Source:** During synchronization of the servers, additional files or folders on the target servers are deleted that are not available on the source server. **Delete Trustees Not On Source:** This option is enabled only for same tree migration. Set this option to update trustee information on target server when trustees are deleted on the source volume on completion of migration or synchronization. Trustee information that is not on the source server is deleted from the target server. **Copy Trustees Only At The Directory Level:** Synchronizes trustees only at the directory level. Trustees for files are not synchronized. **Do Not Copy Trustees:** The user rights on the source server folders are not synced to the target server.
Login Options	This option indicates whether you want users to be logged in during the data migration. **Disable Login On Source:** If you disable user login, the users cannot log in to the network and modify the open files during the file copy. Users already logged in to the source server are not logged out, but no new logins are allowed until the migration completes.

9 After you have finished configuring the parameters in each tab, click **OK** to save your file system migration setup and return to the main Migration window.

10 Click **Migrate** on the main migration window to begin the migration.

Data Synchronization

On successful migration, you are ready to perform synchronization for any new or modified files or trustee rights.

1 Launch the Migration Tool on the target server.

2 Open the migration project that you need to perform synchronization.

The status of the file system is "Migrated on <Date and Time of successful migration>".

3 Authenticate the source server and target server.

4 (Conditional) You can modify only few options for file system. In the **Services to Migrate** panel, select File System, then click Configure. In the **File system** GUI, **File Options** tab only the **Duplicate File Resolution**, **Login Options**, and **Sync Options** are enabled and can be modified.

5 In the main **Migration Tool** GUI, click **Sync**.

All the new or modified files or trustee rights on the source server are migrated to the target server.

Log Information

The following log files are created during the file system migration:

- **filesystem.log:** Stores the information about the command sequence and errors encountered during the migration.
- **filesystem.success.log:** Stores the list of successfully migrated files.
- **filesystem.delete.log:** While performing sync, stores the list of deleted files from the target server, which are not available on the source server.

NOTE: This log file is updated with the list of deleted files only if you select **Delete Files Not On Source** option in the File Options tab.

The log files are available under the migration project location. For more information on migration logs, see View Logs in the OES 2018 SP3: Migration Tool Administration Guide.

Migrating to an Existing NSS64 Volume

The source data can be migrated to an existing NSS64 volume either by migrating to a directory on target volume or merge with the already existing data on the root of target volume. This can be done in the following ways:

- “Migrating to a Directory with Source Volume Name” on page 152
- “Merging With the Existing Data on Target Volume” on page 155

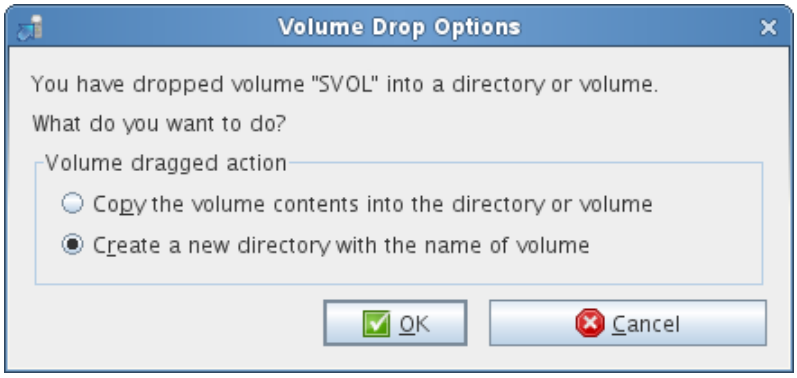
Migrating to a Directory with Source Volume Name

- "Data Migration" on page 152
- "Data Synchronization" on page 155
- "Log Information" on page 155

Data Migration

1 Follow the procedure from Step 2 on page 146 to Step 6 on page 147.

2 In the **Volume Information** tab, in the **Source Server** tree, select volumes or folders that you want to migrate, then drag and drop it in the **Target Server** tree. The **Volume Drop Options** dialog-box is displayed. Select **Create a new directory with the name of volume** option under **Volume dragged action** and then click OK.

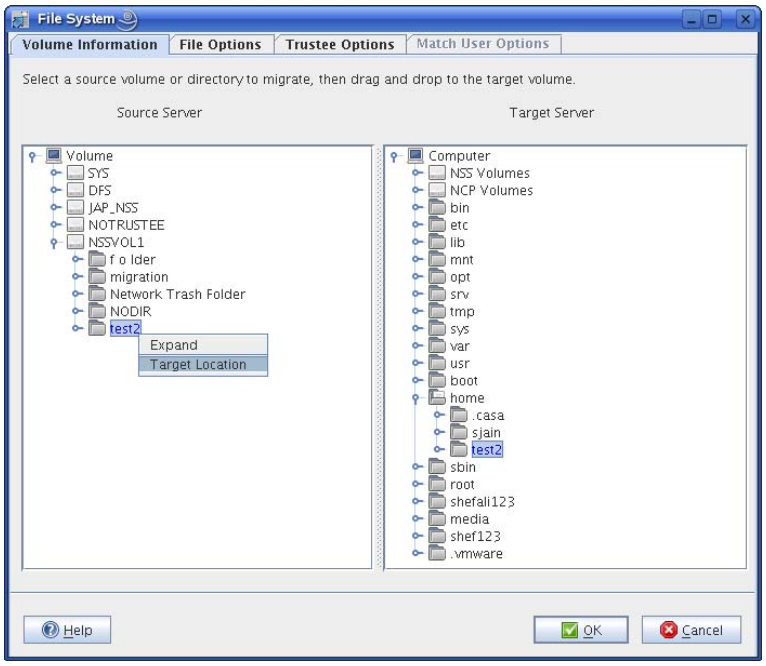
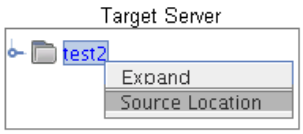

Volume Drop Options
You have dropped volume "SVOL" into a directory or volume.
What do you want to do?
Volume dragged action
Copy the volume contents into the directory or volume
Create a new directory with the name of volume
OK
Cancel

The names of the source cluster volumes can only include "_" as a special character to be listed in the Source Server tree.

IMPORTANT: A DFS junction is displayed under the source tree as a folder because this junction appears in the file structure as a directory. Under **Volume Information**, the DFS junction can be dragged to the target server tree, but actually, the junction and the data are not migrated to the target server and migration fails. However, if you select the source volume that contains the junction for migration and dragged to the target server tree, the junction is migrated to the target server.

In the **Source Server** tree, you cannot expand volumes or folders that are copied to the **Target Server** tree.

For explanation on different tasks that can be performed in the Volume Information tab, refer to the table below, else proceed with default settings to Step 3.

Task	Description
Target Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved to the target server. In the **Source Server** tree, right-click the volume or folder that is selected for migration, then click **Target Location** from the drop-down menu. The tree in the **Target Server** view expands to display the volume or folder that was copied from the source server. 
Source Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved from the source Server. In the **Target Server** tree, right-click the volume or folder that is highlighted for migration, then click **Source Location** from the drop-down menu. The tree in the **Source Server** view expands to display the volume or folder that was copied to the **Target Server**. 
Volumes or Folders selected for migration	The volumes or folders that are selected for migration are highlighted in blue in the Source Server tree and the Target Server tree.
Removing Volumes or Folders from the Target Server	In the target server tree, right-click the volume or folder that you have decided not to migrate, then select **Undo**. The folder no longer appears under the target server tree and is no longer a candidate for migration.

Task	Description
Follow Cluster Resource	Select this option to perform uninterrupted migration when cluster resources migrate to different cluster nodes. This option is valid only on the source server clusters. For example, when a failure occurs on one node of the cluster, the resources are relocated to another node in the cluster. The migration tool connects to the cluster instead of individual server and performs uninterrupted migration during this failure. If this option is not selected, migration stops when the resource migrates to a different node. When the resource comes up on a different node, run the migration project again, the migration tool ensures that the migration process resumes from the state where it had stopped. On migrating data to cluster volume on the target server, migration stops when the resource migrates to a different node. To continue migration you must make the resource active on the target server.

3 Follow the procedure from Step 8 on page 149 to Step 10 on page 151.

After the data migration, the miggui tool does not restore the user quota values that are set on source volume, because the target is not a volume. You can migrate the user quota using `metamig` utility. For more information, see Section B.3, “metamig,” on page 489.

IMPORTANT: Ensure to backup the target volume’s metadata using `metamig` utility.

The `metamig` utility takes the backup of source and then restores on target as follows:

- If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.
- If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then `metamig` adds the quota restriction for user2.smg.idc.microfocus on the target volume.
- If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.

The source volume rights are migrated to the directory with the source volume name in the target location.

Data Synchronization

On successful migration, you are ready to perform synchronization for any new or modified files or trustee rights.

1. Launch the Migration Tool on the target server.
2. Open the migration project that you need to perform synchronization.

   The status of the file system is "Migrated on <Date and Time of successful migration>".
3. Authenticate the source server and target server.
4. (Conditional) You can modify only few options for file system. In the **Services to Migrate** panel, select File System, then click Configure. In the **File system** GUI, **File Options** tab only the **Duplicate File Resolution**, **Login Options**, and **Sync Options** are enabled and can be modified.
5. In the main **Migration Tool** GUI, click **Sync**.

   All the new or modified files or trustee rights on the source server are migrated to the target server.

Log Information

The following log files are created during the file system migration:

- **filesystem.log:** Stores the information about the command sequence and errors encountered during the migration.
- **filesystem.success.log:** Stores the list of successfully migrated files.
- **filesystem.delete.log:** While performing sync, stores the list of deleted files from the target server, which are not available on the source server.

  NOTE: This log file is updated with the list of deleted files only if you select **Delete Files Not On Source** option in the File Options tab.

The log files are available under the migration project location. For more information on migration logs, see View Logs in the OES 2018 SP3: Migration Tool Administration Guide.

Merging With the Existing Data on Target Volume

Before copying the source data at the root of the NSS64 target volume, ensure to meet the following:

- Backup the existing target volume.
- Consider a scenario, where the files and folders with the same name might exist on both the source and target volume, and the access rights (trustees or trustee rights) are different on source and the target volume. On migrating a source volume to an existing target volume, there are access rights (trustees or trustee rights) set on the target volume that can be inherited by the files or folders that are migrated from the source. Before you allow other users to access the migrated data in the new location, you need to modify the settings as required, so that the files are available only to authorized users.
- As source data is going to merge with the existing data, take care of the following:
  - **Duplicate Files:** `miggui` provides options to handle the duplicate files.

- **User Quotas and Trustee Rights:** The user quotas are handled as follows:
  - If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.
  - If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then the quota restriction is added for user2.smg.idc.microfocus on the target volume.
  - If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

  For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.

  Similarly, the trustee rights are also handled.
- **Attributes, IRF, Owner, and Directory Quota:** In case of duplicates files or directories, all these metadata are overwritten with the source.

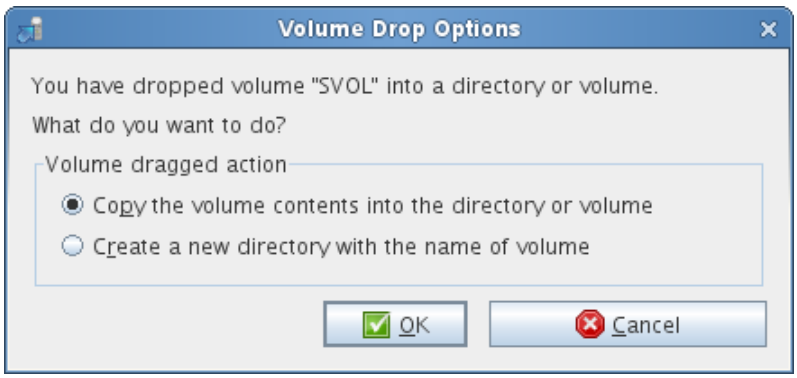
  For example, the source volume contains file (test) with attributes sd, di, aa; and the target volume contains the same file (test) with attributes sd, ri, aa. After migration, the target volume is replaced with the source volume file with attributes sd, di, aa.

This section includes the following:

- "Data Migration" on page 156
- "Data Synchronization" on page 159
- "Log Information" on page 159

Data Migration

1. Follow the procedure from Step 2 on page 146 to Step 6 on page 147.
2. In the **Volume Information** tab, in the **Source Server** tree, select volumes or folders that you want to migrate, then drag and drop it in the **Target Server** tree. The **Volume Drop Options** dialog-box is displayed. Select **Copy the volume contents into the directory or volume** option under **Volume dragged action** and click OK.

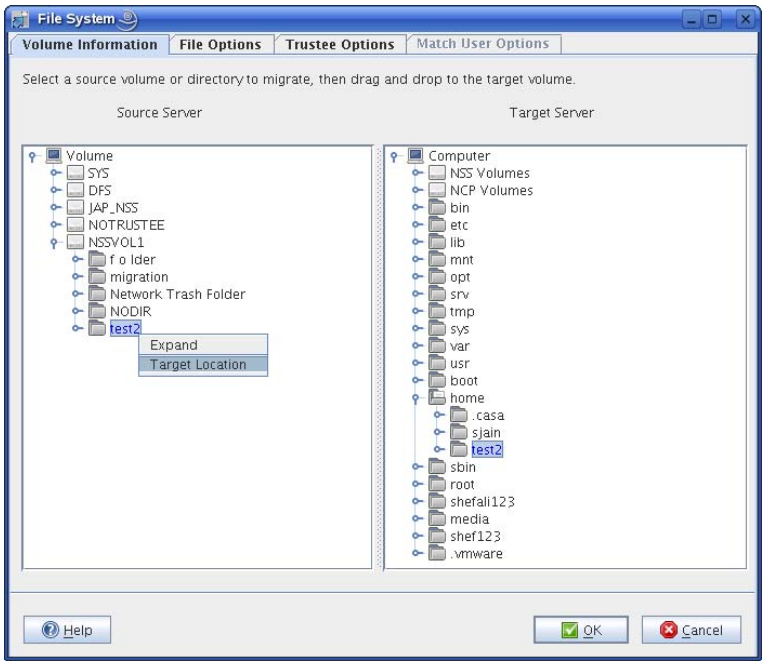
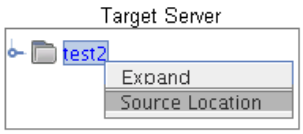

Volume Drop Options
You have dropped volume "SVOL" into a directory or volume.
What do you want to do?
Volume dragged action
Copy the volume contents into the directory or volume
Create a new directory with the name of volume
OK
Cancel

The names of the source cluster volumes can only include "_" as a special character to be listed in the Source Server tree.

IMPORTANT: A DFS junction is displayed under the source tree as a folder because this junction appears in the file structure as a directory. Under **Volume Information**, the DFS junction can be dragged to the target server tree, but actually, the junction and the data are not migrated to the target server and migration fails. However, if you select the source volume that contains the junction for migration and dragged to the target server tree, the junction is migrated to the target server.

In the **Source Server** tree, you cannot expand volumes or folders that are copied to the **Target Server** tree.

For explanation on different tasks that can be performed in the Volume Information tab, refer to the table below, else proceed with default settings to Step 3.

Task	Description
Target Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved to the target server. In the **Source Server** tree, right-click the volume or folder that is selected for migration, then click **Target Location** from the drop-down menu. The tree in the **Target Server** view expands to display the volume or folder that was copied from the source server. 
Source Location	After you have selected volumes and folders for migration, you might want to identify the path of the folder or volume moved from the source Server. In the **Target Server** tree, right-click the volume or folder that is highlighted for migration, then click **Source Location** from the drop-down menu. The tree in the **Source Server** view expands to display the volume or folder that was copied to the **Target Server**. 
Volumes or Folders selected for migration	The volumes or folders that are selected for migration are highlighted in blue in the Source Server tree and the Target Server tree.
Removing Volumes or Folders from the Target Server	In the target server tree, right-click the volume or folder that you have decided not to migrate, then select **Undo**. The folder no longer appears under the target server tree and is no longer a candidate for migration.

Task	Description
Follow Cluster Resource	Select this option to perform uninterrupted migration when cluster resources migrate to different cluster nodes. This option is valid only on the source server clusters. For example, when a failure occurs on one node of the cluster, the resources are relocated to another node in the cluster. The migration tool connects to the cluster instead of individual server and performs uninterrupted migration during this failure. If this option is not selected, migration stops when the resource migrates to a different node. When the resource comes up on a different node, run the migration project again, the migration tool ensures that the migration process resumes from the state where it had stopped. On migrating data to cluster volume on the target server, migration stops when the resource migrates to a different node. To continue migration you must make the resource active on the target server.

3 Follow the procedure from Step 8 on page 149 to Step 10 on page 151.

Data Synchronization

On successful migration, you are ready to perform synchronization for any new or modified files or trustee rights.

1 Launch the Migration Tool on the target server.

2 Open the migration project that you need to perform synchronization.

The status of the file system is "Migrated on <Date and Time of successful migration>".

3 Authenticate the source server and target server.

4 (Conditional) You can modify only few options for file system. In the **Services to Migrate** panel, select File System, then click Configure. In the **File system** GUI, **File Options** tab only the **Duplicate File Resolution**, **Login Options**, and **Sync Options** are enabled and can be modified.

5 In the main **Migration Tool** GUI, click **Sync**.

All the new or modified files or trustee rights on the source server are migrated to the target server.

Log Information

The following log files are created during the file system migration:

- **filesystem.log:** Stores the information about the command sequence and errors encountered during the migration.
- **filesystem.success.log:** Stores the list of successfully migrated files.
- **filesystem.delete.log:** While performing sync, stores the list of deleted files from the target server, which are not available on the source server.

NOTE: This log file is updated with the list of deleted files only if you select **Delete Files Not On Source** option in the File Options tab.

The log files are available under the migration project location. For more information on migration logs, see View Logs in the OES 2018 SP3: Migration Tool Administration Guide.

12.4.4 Migrating Data Using migfiles Utility

This section provides information on how to use the `migfiles` command line utility to migrate the data from NSS32 source to NSS64 target volume. For more information about `migfiles` utility, see migfiles and Security Considerations for Data Migration in the OES 2018 SP3: Migration Tool Administration Guide.

The migration can be done in the following ways:

- "Migrating to Newly Created NSS64 Volume" on page 160
- "Migrating to Existing NSS64 Volume" on page 161

Migrating to Newly Created NSS64 Volume

This section includes the following:

- "Data Migration" on page 160
- "Data Synchronization" on page 161
- "Log Information" on page 161

Data Migration

1. Create a new NSS64 pool and volume on the server or create a new volume on the existing NSS64 pool. For more information, see Section 16.2, "Creating a Pool," on page 212 and Section 19.3, "Creating Unencrypted NSS Volumes," on page 268.
2. Verify the input using `--precheck` option.

   For example,

   ```
   /opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
   verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs/
   sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
   NewProj13/fs/targetpaths.in" --precheck --progress --progress-interval
   1 --source-ldap-port 636 --delete-file-on-restore-error
   ```

   It prompts for username and password. Enter the admin, root username and password.
3. Migrate the data using `migfiles` utility.

   For example,

   ```
   /opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
   verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs0/
   sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
   NewProj13/fs0/targetpaths.in" --progress --progress-interval 1 --
   source-ldap-port 636 --delete-file-on-restore-error 2>&1 | tee /root/
   migration.log
   ```

   `sourcepaths.in`: Contains the source volume mount path. For example, `/media/nss/SVOL`

   `targetpaths.in`: Contains the target volume mount path of a new volume. For example, `/media/nss/TVOL`

`--source-server`: Specifies the source server IP address.

`/root/migration.log`: Specifies the log path for migration output. You can provide any name and location of your choice.

For information on other options of `migfiles` command utility, see migfiles in the OES 2018 SP3: Migration Tool Administration Guide.

NOTE: It is better to use `miggui` utility for data migration as it provides proper logging and monitoring.

Data Synchronization

To sync the data between the source and the target volume, run the following:

```
/opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --verbose
--source-full-path "@/var/opt/novell/migration/NewProj1/fs/sourcepaths.in"
--destination-full-path "@/var/opt/novell/migration/NewProj1/fs/
targetpaths.in" --progress --progress-interval 1 --source-ldap-port 636 --
sync "09-12-2016 05:07:37" --delete-file-on-restore-error 2>&1 | tee /root/
migration.log
```

`--sync "09-12-2016 05:07:37"`: Synchronizes source volume and target volume. When you perform data sync for the 1st time, `"09-12-2016 05:07:37"` indicates the date and time when the data migration is started. For the 2nd time sync, `"09-12-2016 05:07:37"` indicates the previous data sync end date and time.

You can use `--delete-existing-trustees` and `--delete` options to delete the files or trustees that does not exist on the source. For information on other options, see migfiles in the OES 2018 SP3: Migration Tool Administration Guide.

Log Information

The `migfiles` command output is available in the log file mentioned in Step 3 on page 160 and “Data Synchronization” on page 161.

Migrating to Existing NSS64 Volume

The source data can be migrated to existing NSS64 volume either by migrating to a directory on target volume or merge with the already existing data on the root of target volume. This can be done in the following ways:

- “Migrating to a Directory with Source Volume Name” on page 161
- “Merging with the Existing Data in Target Volume” on page 163

Migrating to a Directory with Source Volume Name

This section includes the following:

- “Data Migration” on page 162
- “Data Synchronization” on page 163
- “Log Information” on page 163

Data Migration

1. Create a directory with the source volume name in the existing NSS64 volume.
2. Verify the input using `--precheck` option.

   For example,

   ```
   /opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
   verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs/
   sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
   NewProj13/fs/targetpaths.in" --precheck --progress --progress-interval
   1 --source-ldap-port 636 --delete-file-on-restore-error
   ```

   It prompts for username and password. Enter the admin, root username and password.
3. Migrate the data using `migfiles` utility.

   For example,

   ```
   /opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
   verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs0/
   sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
   NewProj13/fs0/targetpaths.in" --progress --progress-interval 1 --
   source-ldap-port 636 --delete-file-on-restore-error 2>&1 | tee /root/
   migration.log
   ```

   `sourcepaths.in`: Contains the source volume mount path. For example, `/media/nss/SVOL`

   `targetpaths.in`: Contains the target volume mount path of a new volume. For example, `/media/nss/TVOL/SVOL`

   `--source-server`: Specifies the source server IP address.

   `/root/migration.log`: Specifies the log path for migration output. You can provide any name and location of your choice.

For information on other options of `migfiles` command utility, see migfiles in the OES 2018 SP3: Migration Tool Administration Guide.

NOTE: It is better to use `miggui` utility for data migration as it provides proper logging and monitoring.

After the data migration, the `migfiles` utility does not restore the user quota values that are set on source volume, because the target is not a volume. You can migrate the user quota using `metamig` utility. For more information, see Section B.3, “metamig,” on page 489.

IMPORTANT: Ensure to backup the target volume’s metadata using `metamig` utility.

The `metamig` utility takes the backup of source and then restores on target as follows:

- If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.

- If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then `metamig` adds the quota restriction for user2.smg.idc.microfocus on the target volume.
- If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.

The source volume rights are migrated to the directory with the source volume name in the target location.

Data Synchronization

To sync the data between the source and the target volume, run the following:

```
/opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --verbose
--source-full-path "@/var/opt/novell/migration/NewProj1/fs/sourcepaths.in"
--destination-full-path "@/var/opt/novell/migration/NewProj1/fs/
targetpaths.in" --progress --progress-interval 1 --source-ldap-port 636 --
sync "09-12-2016 05:07:37" --delete-file-on-restore-error 2>&1 | tee /root/
migration.log
```

`--sync "09-12-2016 05:07:37"`: Synchronizes source volume and target volume. When you perform data sync for the 1st time, `"09-12-2016 05:07:37"` indicates the date and time when the data migration is started. For the 2nd time sync, `"09-12-2016 05:07:37"` indicates the previous data sync end date and time.

You can use `--delete-existing-trustees` and `--delete` options to delete the files or trustees that does not exist on the source. For information on other options, see migfiles in the OES 2018 SP3: Migration Tool Administration Guide.

Log Information

The `migfiles` command output is available in the log file mentioned in Step 3 on page 162 and “Data Synchronization” on page 163.

Merging with the Existing Data in Target Volume

Before copying the source data at the root of the NSS64 target volume, ensure to meet the following:

- Backup the existing target volume.
- Consider a scenario, where the files and folders with the same name might exist on both the source and target volume, and the access rights (trustees or trustee rights) are different on the source and target volume. On migrating a source volume to an existing target volume, there are access rights (trustees or trustee rights) set on the target volume that can be inherited by the files or folders that are migrated from the source. Before you allow other users to access the migrated data in the new location, you need to modify the settings as required, so that the files are available only to authorized users.

- As source data is going to merge with the existing data, take care of the following:
  - **Duplicate Files:** `migfiles` provides options to handle the duplicate files.
  - **User Quotas and Trustee Rights:** The user quotas are handled as follows:
    - If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.
    - If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then the quota restriction is added for user2.smg.idc.microfocus on the target volume.
    - If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

    For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.

    Similarly, the trustee rights are also handled.
  - **Attributes, IRF, Owner, and Directory Quota:** In case of duplicates files or directories, all these metadata are overwritten with the source.

    For example, the source volume contains file (test) with attributes sd, di, aa; and the target volume contains the same file (test) with attributes sd, ri, aa. After migration, the target volume is replaced with the source volume file with attributes sd, di, aa.

This section includes the following:

- "Data Migration" on page 164
- "Data Synchronization" on page 165
- "Log Information" on page 165

Data Migration

1 Verify the input using `--precheck` option.

For example,

```
/opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs/
sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
NewProj13/fs/targetpaths.in" --precheck --progress --progress-interval
1 --source-ldap-port 636 --delete-file-on-restore-error
```

It prompts for username and password. Enter the admin, root username and password.

2 Migrate the data using `migfiles` utility.

For example,

```
/opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --
verbose --source-full-path "@/var/opt/novell/migration/NewProj13/fs0/
sourcepaths.in" --destination-full-path "@/var/opt/novell/migration/
```

```
NewProj13/fs0/targetpaths.in" --progress --progress-interval 1 --
source-ldap-port 636 --delete-file-on-restore-error 2>&1 | tee /root/
migration.log
```

sourcepaths.in: Contains the source volume mount path. For example, `/media/nss/SVOL`

targetpaths.in: Contains the target volume mount path of a new volume. For example, `/media/nss/TVOL`

--source-server: Specifies the source server IP address.

/root/migration.log: Specifies the log path for migration output. You can provide any name and location of your choice.

NOTE: In case of duplicate files, you can use `--never-overwrite` and `--update-ifnewer` options to take specific action on duplicate files during migration.

Data Synchronization

To sync the data between the source and the target volume, run the following:

```
/opt/novell/migration/sbin/migfiles --source-server 192.168.1.10 --verbose
--source-full-path "@/var/opt/novell/migration/NewProj1/fs/sourcepaths.in"
--destination-full-path "@/var/opt/novell/migration/NewProj1/fs/
targetpaths.in" --progress --progress-interval 1 --source-ldap-port 636 --
sync "09-12-2016 05:07:37" --delete-file-on-restore-error 2>&1 | tee /root/
migration.log
```

--sync "09-12-2016 05:07:37": Synchronizes source volume and target volume. When you perform data sync for the 1st time, `"09-12-2016 05:07:37"` indicates the date and time when the data migration is started. For the 2nd time sync, `"09-12-2016 05:07:37"` indicates the previous data sync end date and time.

You can use `--delete-existing-trustees` and `--delete` options to delete the files or trustees that does not exist on the source. For information on other options, see migfiles in the OES 2018 SP3: Migration Tool Administration Guide.

Log Information

The `migfiles` command output is available in the log file mentioned in Step 2 on page 164 and “Data Synchronization” on page 165.

12.4.5 Migrating Data Using Distributed File Services (DFS)

Distributed File Services (DFS) for the OES Storage Services (NSS) file system provides location transparency of file data to end users. With DFS, you can create a single virtual file system for data on NSS volumes that spans multiple machines to maximize the use and performance of storage resources.

The DFS Move operation can be used to migrate the data to a new volume. For more information about DFS, see OES 2018 SP3: Distributed File Services Administration Guide for Linux.

Migrating to Newly Created NSS64 Volume

This section includes the following:

- “Data Migration” on page 166
- “Data Synchronization” on page 166
- “Log Information” on page 166

Data Migration

For information about migrating data to newly created NSS64 volume, see Using DFS to Move NSS Volumes in the OES 2018 SP3: Distributed File Services Administration Guide for Linux.

IMPORTANT: After successful completion of DFS Move operation, the source volume can be deleted and moved to Salvage sub-system or permanently deleted. This can be managed by configuring the server’s **ImmediatePurgeOfDeletedFiles** and **Purge Delay** settings. For more information, see Moving an NSS Volume with DFS in the OES 2018 SP3: Distributed File Services Administration Guide for Linux.

Data Synchronization

DFS does not provide any options to synchronize the data. Ensure that the files are not in use, when DFS Move job is running. For more information about job status, see Understanding the Job Status Report in the OES 2018 SP3: Distributed File Services Administration Guide for Linux.

Log Information

For information about DFS log, see Managing Move Volume or Split Volume Jobs in the OES 2018 SP3: Distributed File Services Administration Guide for Linux.

NOTE: DFS does not support migrating data to an existing NSS volume.

12.4.6 Migrating Data Using Dynamic Storage Technology (DST)

Dynamic Storage Technology (DST) for Open Enterprise Server (OES) is an information life-cycle management technology. It makes your essential data readily available to the eDirectory and Active Directory users, while tiering files efficiently across a pair of independent NSS volumes, referred to as a DST shadow volume. You create policies to control how the files are distributed between the two volumes.

The two NSS volumes reside on different devices on the same server. The primary volume typically contains active or highly critical files, while the secondary volume contains files that are accessed less often. When users connect to a network share on the primary NSS volume, they see a merged view of files on both volumes. Users are not aware of where the files physically reside. Files on both volumes are equally accessible to users. DST pulls data directly to the user from the primary volume or the secondary volume, depending on where the file is located.

For more information about DST, see the following:

- OES 2018 SP3: Dynamic Storage Technology Administration Guide
- The data can be migrated from NSS32 to NSS64 volume in two ways: First, the DST pair can be created by using the existing NSS32 source as primary volume and new NSS64 target as secondary volume. Second, the new NSS64 target as primary volume and the existing NSS32 source as secondary volume. The DST policies can be configured to move the data from primary to secondary volume or secondary to primary volume. For more information, see Shadowing Scenarios in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

IMPORTANT: If a file is hard link enabled, and it is moved between the primary and the secondary volume, the move actually copies the file and breaks the hard link. It creates an additional version of the file that is not linked to an other file.

The data migration from NSS32 volume to NSS64 volume using DST can be done only in the following way:

- "Migrating to Newly Created NSS64 Volume" on page 167

NOTE: DST does not support migrating data to an existing NSS volume.

Migrating to Newly Created NSS64 Volume

The source data can be migrated to newly created NSS64 volume in the following ways:

- "Existing NSS32 Volume as Primary Volume and Newly Created NSS64 Volume as Secondary Volume" on page 167
- "Existing NSS32 Volume as Secondary Volume and Newly Created NSS64 Volume as Primary Volume" on page 168

Existing NSS32 Volume as Primary Volume and Newly Created NSS64 Volume as Secondary Volume

This section includes the following:

- "Data Migration" on page 167
- "Data Synchronization" on page 168
- "Log Information" on page 168

Data Migration

1. Create a new NSS64 pool and volume on the server or create a new volume on an existing NSS64 pool.
2. Create a DST pair for the above mentioned volumes.
   - **Non-Clustered:** For information about creating an unshared DST shadow volumes, see Creating a DST Shadow Volume with NSS Volumes in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

- **Clustered:** For information about using shared NSS volumes to create a shared DST shadow volume in a cluster environment, see Configuring DST Shadow Volume Pairs with OES Cluster Services in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

3 Create a policy to move the data from primary NSS32 volume to secondary NSS64 volume. For more information about policy settings, see Creating a Shadow Volume Policy in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

4 Migrate the data using the policy created in Step 3 on page 168.

5 Remove the shadow relationship after the data is successfully migrated.

- **Non-Clustered:** For more information, see Removing the Shadow Relationship for a Non-Clustered DST Shadow Volume in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.
- **Clustered:** For more information, see Removing the Shadow Relationship for a Clustered DST Volume Pair in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

Data Synchronization

DST does not provide any options to synchronize the data. Ensure that the files are not in use, when policy is running. When DST enforce the policies or move files, the relocation request fails if any user has opened the file. Only, those files that are not in use will be moved. The policy should be run one more time to copy the files that were missed during the first attempt.

Log Information

To view the log information, see the following:

- Viewing DST Policies and Policy Status
- Viewing Information about the Files Moved During a Policy Run

Existing NSS32 Volume as Secondary Volume and Newly Created NSS64 Volume as Primary Volume

This section includes the following:

- "Data Migration" on page 168
- "Data Synchronization" on page 169
- "Log Information" on page 169

Data Migration

1 Create a new NSS64 pool and volume on the server or create a new volume on an existing NSS64 pool.

2 Synchronize the quota settings.

When the secondary volume contains the data, the existing trustees are overwritten when the trustees database is synchronized from the new primary volume. There is no automatic way to synchronize the setting from the secondary volume to the primary volume. The `ncpcon quotas` command does not synchronize quotas settings from secondary to primary. To copy the trustee settings, user quota and directory quota settings, see Getting Quotas from an Old Secondary Volume to a New Primary Volume in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

3 Create a DST pair for the above mentioned volumes.

- **Non-Clustered:** For information about creating an unshared DST shadow volumes, see Creating a DST Shadow Volume with NSS Volumes in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.
- **Clustered:** For information about using shared NSS volumes to create a shared DST shadow volume in a cluster environment, see Configuring DST Shadow Volume Pairs with OES Cluster Services in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

4 Replicate the file tree structure from secondary to primary volume.

For more information, see Replicating the Secondary File Tree Structure to the Primary Volume in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

5 Create a policy to move the data from secondary NSS32 volume to primary NSS64 volume. For more information about policy settings, see Creating a Shadow Volume Policy in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

6 Migrate the data using the policy created in Step 5 on page 169.

7 Remove the shadow relationship after the data is successfully migrated.

- **Non-Clustered:** For more information, see Removing the Shadow Relationship for a Non-Clustered DST Shadow Volume in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.
- **Clustered:** For more information, see Removing the Shadow Relationship for a Clustered DST Volume Pair in the OES 2018 SP3: Dynamic Storage Technology Administration Guide.

Data Synchronization

DST does not provide any options to synchronize the data. Ensure that the files are not in use, when policy is running. When DST enforce the policies or move files, the relocation request fails if any user has opened the file. Only, those files that are not in use will be moved. The policy should be run one more time to copy the files that are missed during the first attempt.

Log Information

To view the log information, see the following links:

- Viewing DST Policies and Policy Status
- Viewing Information about the Files Moved During a Policy Run

12.4.7 Migrating Data Using rsync Utility

Using `rsync` command line utility, the data can be migrated with the support of extended attributes. For more information about the `rsync` utility, see rsync.

The data migration using `rsync` utility can be done in the following ways:

- “Migrating to Newly Created NSS64 Volume” on page 170
- “Migrating to Existing NSS64 Volume” on page 171

Migrating to Newly Created NSS64 Volume

This section includes the following:

- "Data Migration" on page 170
- "Data Synchronization" on page 171
- "Log Information" on page 171

Data Migration

1 Create a NSS64 pool and volume on the target server or create a new volume on an existing NSS64 pool.

For more information about creating a NSS64 pool and volume, see Section 16.2, "Creating a Pool," on page 212 and Section 19.3, "Creating Unencrypted NSS Volumes," on page 268.

2 Enable extended attributes (XAttr) extension for NSS to allow you to read, backup, and restore extended attributes of files on NSS.

For example, to enable the return of `netware.metadata` information, enter the following in the NSS console:

```
nss /ListXattrNWmetadata
```

For more information, see Section A.11, "Extended Attributes (XAttr) Commands," on page 449.

NOTE: If the source and target volume are on the different servers, execute this step on both the servers.

IMPORTANT: Using `-X` option will have huge impact on overall achievable throughput. Therefore, it is better to use `rsync` without `-X` option and use `metamig` utility to transfer the trustees and quotas.

---

3 Run the following command on target server to migrate the data.

- If both the source volume and target volume are on the same server:

```
rsync -v -r -h -lXHtS /media/nss/<Source_Volume>/ /media/nss/
<Target_Volume>/ --stats --log-file=<logfile_path>
```

- If the source volume and target volume are on the different servers:

```
rsync -v -r -h -lXHtS root@<Source_Server_IP or
Cluster_Resource_IP>:/media/nss/<Source_Volume>/ /media/nss/
<Target_Volume>/ --stats --log-file=<logfile_path>
```

For example,

- If both the source volume and target volume are on the same server:

```
rsync -v -r -h -lXHtS /media/nss/TEST1/ /media/nss/TEST2/ --stats -
-log-file=/var/opt/novell/log/rsync
```

- If the source volume and target volume are on the different servers:

```
rsync -v -r -h -lXHtS root@192.168.1.10:/media/nss/TEST1/ /media/
nss/TEST2/ --stats --log-file=/var/opt/novell/log/rsync
```

NOTE: `rsync` utility has multiple options for file transfer. For information on other options, see rsync.

Data Synchronization

Use the same command provided in Step 3 on page 170 to sync the data between the source and target volume. By default, it overwrites the data on the target volume with the source data. You can use `--update` or `--ignore-existing` options to modify this behavior.

Log Information

The `rsync` command output is available in the log file provided in Step 3 on page 170.

Migrating to Existing NSS64 Volume

The source data can be migrated to existing NSS64 volume either by migrating to a directory on target volume or merge with the already existing data on the root of target volume. This can be done in the following ways:

- “Migrating to a Directory with Source Volume Name” on page 171
- “Merging with the Existing Data on Target Volume” on page 173

Migrating to a Directory with Source Volume Name

This section includes the following:

- “Data Migration” on page 171
- “Data Synchronization” on page 172
- “Log Information” on page 172

Data Migration

IMPORTANT: Ensure to backup the target volume’s metadata using `metamig` utility.

1. Create a directory with the source volume name in the existing NSS64 volume.
2. Enable extended attributes (XAttr) extension for NSS to allow you to read, backup, and restore extended attributes of files on NSS.

   For example, to enable the return of `netware.metadata` information, enter the following in the NSS console:

   ```
   nss /ListXattrNWmetadata
   ```

   For more information, see Section A.11, “Extended Attributes (XAttr) Commands,” on page 449.

   NOTE: If the source and target volume are on the different servers, execute this step on both the servers.

   IMPORTANT: Using `-X` option will have huge impact on overall achievable throughput. Therefore, it is better to use `rsync` without `-X` option and use `metamig` utility to transfer the trustees and quotas.

3 Run the following command on target server to migrate the data.

- If both the source volume and target volume are on the same server:

  ```
  rsync -v -r -h -lXHtS /media/nss/<Source_Volume>/ /media/nss/
  <Target_Volume>/<Directory_with_Source_Volume_Name>/ --stats --log-
  file=<logfile_path>
  ```

- If the source volume and target volume are on the different servers:

  ```
  rsync -v -r -h -lXHtS root@<Source_Server_IP or
  Cluster_Resource_IP>:/media/nss/<Source_Volume>/ /media/nss/
  <Target_Volume>/<Directory_with_Source_Volume_Name>/ --stats --log-
  file=<logfile_path>
  ```

For example,

- If both the source volume and target volume are on the same server:

  ```
  rsync -v -r -h -lXHtS /media/nss/TEST1/ /media/nss/TEST2/TEST1/ --
  stats --log-file=/var/opt/novell/log/rsync
  ```

- If the source volume and target volume are on the different servers:

  ```
  rsync -v -r -h -lXHtS root@192.168.1.10:/media/nss/TEST1/ /media/
  nss/TEST2/TEST1/ --stats --log-file=/var/opt/novell/log/rsync
  ```

After the data migration, the user quota of source volume is merged with the target volume as follows:

- If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.
- If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then the quota restriction is added for user2.smg.idc.microfocus on the target volume.
- If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.

Data Synchronization

Use the same command provided in Step 3 on page 172 to sync the data between the source and target volume. By default, it overwrites the data on the target volume with the source data. You can use `--update` or `--ignore-existing` options to modify this behavior.

Log Information

The `rsync` command output is available in the log file provided in Step 3 on page 172.

Merging with the Existing Data on Target Volume

Before copying the source data at the root of the NSS64 target volume, ensure to meet the following:

- Backup the existing target volume.
- Consider a scenario, where the files and folders with the same name might exist on both the source and target volume, and the access rights (trustees or trustee rights) are different on source and the target volume. On migrating a source volume to an existing target volume, there are access rights (trustees or trustee rights) set on the target volume that can be inherited by the files or folders that are migrated from the source. Before you allow other users to access the migrated data in the new location, you need to modify the settings as required, so that the files are available only to authorized users.
- As source data is going to merge with the existing data, take care of the following:
  - **Duplicate Files:** `rsync` provides options to handle the duplicate files.
  - **User Quotas:** Is handled as follows:
    - If both the source and target volume has quota set for the same user (user1.wpg.idc.microfocus), the quota for user1.wpg.idc.microfocus on target volume is overwritten with the source volume.
    - If user quota is set for user2.smg.idc.microfocus on source volume but not on the target volume, then the quota restriction is added for user2.smg.idc.microfocus on the target volume.
    - If user quota is set for user3.wpg.idc.microfocus on target volume but not on the source volume, then the quota value is retained for user3.wpg.idc.microfocus on the target volume.

    For example, the source volume contains two users, user1.wpg.idc.microfocus and user2.smg.idc.microfocus with user quota 5 GB and 3 GB respectively. The target volume also contains two users, user1.wpg.idc.microfocus and user3.wpg.idc.microfocus with user quota 2 GB and 3 GB respectively. After migration, the target volume contains three users: user1.wpg.idc.microfocus, user2.smg.idc.microfocus, and user3.wpg.idc.microfocus with user quota 5 GB, 3 GB and 3 GB respectively.
  - **Attributes, IRF, Owner, Directory Quota, and Trustee Rights:** In case of duplicates files or directories, all these metadata are overwritten with the source.

    For example, the source volume contains file (test) with attributes sd, di, aa; and the target volume contains the same file (test) with attributes sd, ri, aa. After migration, the target volume is replaced with the source volume file with attributes sd, di, aa.

This section includes the following:

- "Data Migration" on page 173
- "Data Synchronization" on page 174
- "Log Information" on page 174

Data Migration

1 Enable extended attributes (XAttr) extension for NSS to allow you to read, backup, and restore extended attributes of files on NSS.

For example, to enable the return of `netware.metadata` information, enter the following in the NSS console:

```
nss /ListXattrNWmetadata
```

For more information, see Section A.11, “Extended Attributes (XAttr) Commands,” on page 449.

NOTE: If the source and target volume are on the different servers, execute this step on both the servers.

IMPORTANT: Using `-X` option will have huge impact on overall achievable throughput. Therefore, it is better to use `rsync` without `-X` option and use `metamig` utility to transfer the trustees and quotas.

---

2 Run the following command on target server to migrate the data.

- If both the source volume and target volume are on the same server:

  ```
  rsync -v -r -h -lXHtS /media/nss/<Source_Volume>/ /media/nss/
  <Target_Volume>/ --stats --log-file=<logfile_path>
  ```

- If the source volume and target volume are on the different servers:

  ```
  rsync -v -r -h -lXHtS root@<Source_Server_IP or
  Cluster_Resource_IP>:/media/nss/<Source_Volume>/ /media/nss/
  <Target_Volume>/ --stats --log-file=<logfile_path>
  ```

For example,

- If both the source volume and target volume are on the same server:

  ```
  rsync -v -r -h -lXHtS /media/nss/TEST1/ /media/nss/TEST2/ --stats -
  -log-file=/var/opt/novell/log/rsync
  ```

- If the source volume and target volume are on the different servers:

  ```
  rsync -v -r -h -lXHtS root@192.168.1.10:/media/nss/TEST1/ /media/
  nss/TEST2/ --stats --log-file=/var/opt/novell/log/rsync
  ```

In case of duplicate files, you can use `--update`, `--backup` or `--ignore-existing` options. By default, it overwrites the existing file.

Data Synchronization

Use the same command provided in Step 2 on page 174 to sync the data between the source and target volume. By default, it overwrites the data on the target volume with the source data. You can use `--update` or `--ignore-existing` options to modify this behavior.

Log Information

The `rsync` command output is available in the log file provided in Step 2 on page 174.

13 Managing Partitions

OES Storage Services automatically manages partitions used under the software RAID devices and NSS pools, whether you create RAIDs and pools in the Storage plug-in for iManager or the NSS Management Utility.

- Section 13.1, “Understanding Partitions,” on page 175
- Section 13.2, “Viewing a List of Partitions,” on page 177
- Section 13.3, “Viewing Details for a Partition,” on page 179
- Section 13.4, “Deleting an NSS Partition,” on page 179
- Section 13.5, “Adding Other Types of File System Partitions,” on page 181

13.1 Understanding Partitions

- Section 13.1.1, “NSS Partitions,” on page 175
- Section 13.1.2, “Understanding Types of Partitions,” on page 175
- Section 13.1.3, “Understanding Partition Details,” on page 176

13.1.1 NSS Partitions

A partition is a logical division of a physical hard drive. NSS abstracts all partition creation and deletion in iManager and NSSMU through the **Pools** page and the **Software RAIDs** page. When you create NSS pools or NSS software RAID devices, NSS automatically creates the NSS partitions on the devices you specify. You can view and label these NSS partitions from the **Partitions** page.

Partitions are automatically managed by NSS whenever you create pools. You do not manage NSS partitions directly.

The OES Linux Volume Manager (NLVM) tool is used to manage devices and partitions.

13.1.2 Understanding Types of Partitions

The following table describes the variety of partition types for an OES system:

The Partitions function in iManager and NSSMU is intended simply as a reporting tool so that you can see the types of partitions that are being virtualized by higher-level storage entities such as pools or software RAID devices. Generally, you cannot create or modify partitions with iManager or NSSMU tools. NSS partitions are created for you automatically when you create a pool. There might be multiple NSS partitions that are aggregated and managed underneath the single pool of space. Similarly, the tools automatically create a Virtual Device when you create a software RAID device.

Table 13-1 *Explanation of Partition Types*

Partition Type	Description
Cluster Service	A partition used to monitor cluster connectivity and services; it appears only in shared devices in the cluster.
DOS	A conventional DOS partition.
GPT	GUID Partition Table (GPT) scheme.
Ext3	The partition type for Linux Extended File System 3.
iSCSI	A partition in a target disk server in an iSCSI storage area network; it appears as an iSCSI device to file servers with iSCSI initiator software.
NSS	The primary partition type for NSS file systems.
Reiser	The partition type for Linux Reiser file systems.
System Configuration	A vendor-specific partition for maintaining metadata about the server configuration.
Unknown	An partition type that is unknown to the current operating system.
Virtual Device	A partition that serves as a partition in a software RAID 0 or RAID 5 device.

13.1.3 Understanding Partition Details

You can view the following information about partitions:

Table 13-2 *Explanation of Partition Details*

Partition Detail	Description
Partition ID	The partition name assigned by the device manager.
Partition Name	The physical descriptive name of the partition that corresponds to the device's physical descriptive name, followed by the type of partition it is.
Type	The abbreviated name of the partition type.
Status	Specifies if a partition is In Use or Available.
Label	The partition name assigned by the administrator.
Starting Offset	Amount of space on the disk that precedes the beginning of the selected partition.
Size	The storage capacity of this partition.
Device Name	The physical descriptive name of the device where the partition exists. For software RAIDs, the description might include RAID 0, RAID 1, or RAID 5.
Device ID	The device name assigned by the device manager.
Pool Name	For NSS partitions, specifies the name of the pool that uses the partition.

13.2 Viewing a List of Partitions

The Partitions page in the Storage plug-in to iManager and in NSSMU is a reporting tool that allows you to view a list of partitions. You can view the types of partitions that are being virtualized by higher-level storage entities such as NSS pools or software RAID devices.

In iManager, you can use the Partitions page, or access information about partitions through a related task.

- Section 13.2.1, “Viewing Partitions on the Server,” on page 177
- Section 13.2.2, “Viewing Partitions on a Device,” on page 177
- Section 13.2.3, “Viewing Partitions in a Software RAID Device,” on page 178
- Section 13.2.4, “Viewing Partitions in an NSS Pool,” on page 178

13.2.1 Viewing Partitions on the Server

The Partitions page in iManager reports the partitions that it finds on a selected server, and displays information about them.

1 In iManager, click **Storage > Partitions**.

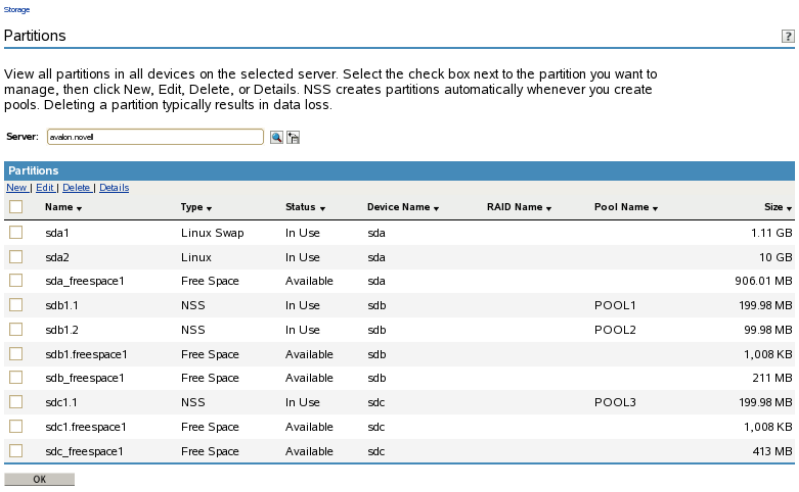
For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select the server that you want to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 View the list of partitions on the device.

For information about the partition types, see Section 13.1, “Understanding Partitions,” on page 175.


Storage
Partitions
View all partitions in all devices on the selected server. Select the check box next to the partition you want to manage, then click New, Edit, Delete, or Details. NSS creates partitions automatically whenever you create pools. Deleting a partition typically results in data loss.
Server: avalon.novell
Partitions
New | Edit | Delete | Details
Name | Type | Status | Device Name | RAID Name | Pool Name | Size
sda1 | Linux Swap | In Use | sda | | | 1.11 GB
sda2 | Linux | In Use | sda | | | 10 GB
sda_freespace1 | Free Space | Available | sda | | | 906.01 MB
sdb1.1 | NSS | In Use | sdb | | POOL1 | 199.98 MB
sdb1.2 | NSS | In Use | sdb | | POOL2 | 99.98 MB
sdb1.freespace1 | Free Space | Available | sdb | | | 1,008 KB
sdb_freespace1 | Free Space | Available | sdb | | | 211 MB
sdc1.1 | NSS | In Use | sdc | | POOL3 | 199.98 MB
sdc1.freespace1 | Free Space | Available | sdc | | | 1,008 KB
sdc_freespace1 | Free Space | Available | sdc | | | 413 MB
OK

13.2.2 Viewing Partitions on a Device

1 In iManager, click **Storage > Devices**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select the server that you want to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Devices** list, select a device.

4 In the **Details** area, click the arrow on the **Partitions** drop-down list to expand it.

5 Select a partition, then click the **View Details** icon.

The **Partitions** page displays a list of all the partitions that currently exist on the selected device.

13.2.3 Viewing Partitions in a Software RAID Device

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select the server that you want to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Software RAIDs** list, select a device.

Wait for the page to refresh before continuing.

4 In the **Details** area, click the arrow on the **Partitions** drop-down list to expand it.

5 To view details about partitions, click the **View Partition Details** icon.

This opens the **Partitions** page. It displays a list of all the partitions that currently exist on the selected device.

6 Select a partition from the **Partitions** list, then click **Details** to view more information.

13.2.4 Viewing Partitions in an NSS Pool

Although NSS abstracts the partitions underlying the pool structure, you can view information about those partitions.

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select the server that you want to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Pools** list, select the pool you want to manage.

Wait for the page to refresh and display the details. The pool must be active to see partition details.

4 If the pool is deactive, make sure the pool is selected, then click **Activate**.

After the page refreshes, the **Partitions** drop-down list is available.

5 Click on the arrow next to the **Partitions** drop-down list to expand the list.

6 To view details about the partitions, click the **View Partition Details** icon.

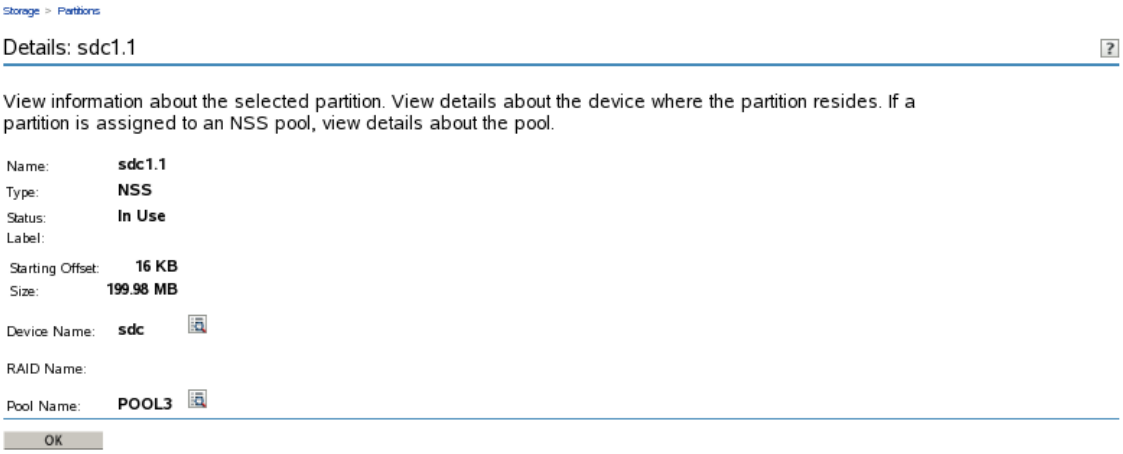
A **Partitions** page opens where you can view details about the pool’s partitions.

7 Select a partition from the **Partitions** list, then click **Details** to view more information.

13.3 Viewing Details for a Partition

1. In iManager, go to the **Storage > Partitions** page, then select a server.
2. in the list of Partitions, select a partition.
3. Click **Details** to view its **Partition Details** page.

   For information about the details, see Section 13.1.3, “Understanding Partition Details,” on page 176.


Storage > Partitions
Details: sdc1.1
View information about the selected partition. View details about the device where the partition resides. If a partition is assigned to an NSS pool, view details about the pool.
Name: sdc1.1
Type: NSS
Status: In Use
Label:
Starting Offset: 16 KB
Size: 199.98 MB
Device Name: sdc
RAID Name:
Pool Name: POOL3
OK

4. Click the **View Details** icon next to the **Device Name** to go to the Devices page.

   The device is preselected and its details are displayed automatically on the right.
5. Click the **View Details** icon next to the **Pool Name** to go to the Pools page.

   The pool is preselected and its details are displayed automatically on the right.

13.4 Deleting an NSS Partition

Deleting a partition results in data loss. We recommend that you delete the storage structure that uses the partition instead of deleting the partition itself.

- Section 13.4.1, “Deleting Partitions in a Pool,” on page 179
- Section 13.4.2, “Deleting Partitions in an NSS Software RAID Device,” on page 179

13.4.1 Deleting Partitions in a Pool

You cannot shrink the size of a pool by deleting its partitions. Use the Pools page in iManager or NSSMU to delete the pool. For information, see Section 16.6, “Deleting a Pool,” on page 220.

13.4.2 Deleting Partitions in an NSS Software RAID Device

You can delete all of the partitions in a software RAID device by deleting the software RAID. For information, see Section 14.16, “Deleting a Software RAID Device,” on page 205.

For NSS software RAIDs that provide fault-tolerance, there is limited support for deleting individual partitions used in the RAID.

NSS Software RAID	Delete a Partition (Yes/No)	Guidelines
RAID 0	No	Delete the RAID to remove its partitions.
RAID 1 (mirror)	Yes	Delete the RAID, or delete all but one partition.
RAID 5	Yes	Delete the RAID, or delete only one failed partition at a time to repair and restore the RAID. See also Section 14.15, “Replacing a Failed Segment in a Software RAID,” on page 202.

For NSS software RAID devices, use the Software RAIDs page in iManager or NSSMU to access and delete its partitions.

- “Using iManager to Delete a Partition in a Software RAID” on page 180
- “Using NSSMU to Delete a Partition in a Software RAID” on page 180

Using iManager to Delete a Partition in a Software RAID

The Storage plug-in to iManager does not allow you to delete partitions from the Partitions page because it is designed to abstract all partition management. To delete a single partition in a software RAID 1 or RAID 5 device:

1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select the server that you want to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Software RAIDs** list, select the software RAID 1 or RAID 5 device you want to manage.

   Wait for the page to refresh and display the details.
4. Click the **View Partition Details** icon to open the **Partitions** page for the selected software RAID.
5. Select a partition, then click **Delete** to delete the partition and its contents.

Using NSSMU to Delete a Partition in a Software RAID

NSSMU allows you to delete any NSS partition directly from the Partitions page.

1. In NSSMU, select **Partitions**.
2. Select the partition you want to delete.
3. Click **Delete** to delete the partition and its contents, then click **OK** to confirm deletion.

13.5 Adding Other Types of File System Partitions

NSS and Linux POSIX file systems can co-exist on a device. To create a NSS and Linux POSIX partitions on the same device, the first partition must be a Linux partition. In this mixed mode, you can have maximum 15 partitions. We recommend you to create four partitions only, if you are using DOS partitioned disks.

If the first partition on your device is a NSS partition, then you can not create a Linux POSIX file system partition on the same device.

Use NSSMU or the iManager Storage plug-in to manage NSS pools and volumes on OES. Use the NSSMU, NLVM, or iManager to create Linux POSIX file systems on the device.

Do not use YaST or LVM2 management tools to create or manage NSS pools and volumes. During the partition creation process, the YaST partitioner modifies the `/etc/fstab` configuration file to incorrectly identify NSS pools as Ext3 partitions instead of NSS partitions. This can make your system unbootable.

For example, a command like this is added to the `/etc/fstab` file for each NSS pool:

`/dev/pool/`*`poolname`* `/nss/.pools/`*`poolname`* `ext3 defaults 1 2`

where *poolname* is the name of the pool.

Instead of `ext3`, the partition type should be `nss`:

`/dev/pool/`*`poolname`* `/nss/.pools/`*`poolname`* `nss defaults 1 2`

To work around this problem when using the YaST partitioner, after you create a Linux POSIX file system and before you reboot your system, edit the `/etc/fstab` file to remove or comment out the lines that identify NSS partitions as Ext3 partitions.

To recover your system if you reboot your server before editing the `/etc/fstab` file:

1. Boot your OES server in Single User mode.
2. Mount the root (`/`) file system with the `remount` and read/write (`rw`) options by entering the following at a terminal console prompt:

   ```
   mount -n -o remount,rw /
   ```

3. Edit the `/etc/fstab` file to do the following, then save the file:
   - If a line wrongly identifies an NSS partition as an Ext3 partition, correct the entry by changing `ext3` to `nss`.
   - If a line wrongly identifies an NSS partition as an Ext3 partition, and if the entry duplicates a correct entry for the NSS partition, then remove or comment out the line that wrongly identifies the NSS partition as an Ext3 partition.
4. Reboot the server to apply the changes.

14 Managing NSS Software RAID Devices

RAID devices help provide data fault tolerance for storage devices. In some RAID configurations, the read/write performance is also improved. The OES Storage Services (NSS) File System supports software RAIDs 0, 1, 5, 0+1, and 5+1.

This section describes the following:

- Section 14.1, “Understanding Software RAID Devices,” on page 183
- Section 14.2, “Planning for a Software RAID Device,” on page 185
- Section 14.3, “Viewing a List of Software RAID Devices on a Server,” on page 189
- Section 14.4, “Viewing Details of a Software RAID Device,” on page 190
- Section 14.5, “Creating Software RAID Devices with iManager,” on page 192
- Section 14.6, “Creating Software RAID Devices with NSSMU,” on page 195
- Section 14.7, “Mirroring an Existing Pool with NSSMU,” on page 196
- Section 14.8, “Recovering a Mirror where All Elements Report ‘Not in Sync’ Using NSSMU,” on page 197
- Section 14.9, “Creating a RAID 1 Mirror to Duplicate Data,” on page 198
- Section 14.10, “Creating a Software RAID 0+1 with NSSMU,” on page 198
- Section 14.11, “Creating a Software RAID 5+1 with NSSMU,” on page 199
- Section 14.12, “Renaming a Software RAID Device,” on page 199
- Section 14.13, “Increasing the Size of a Software RAID Device,” on page 200
- Section 14.14, “Restriping a Software RAID,” on page 201
- Section 14.15, “Replacing a Failed Segment in a Software RAID,” on page 202
- Section 14.16, “Deleting a Software RAID Device,” on page 205
- Section 14.17, “Viewing Pools on a Software RAID Device,” on page 205
- Section 14.18, “Viewing Partitions on a Software RAID Device,” on page 206
- Section 14.19, “Deleting Partitions on a Software RAID Device,” on page 206
- Section 14.20, “Managing Software RAID Devices with NSSMU,” on page 207

14.1 Understanding Software RAID Devices

A software RAID is a configuration for storage devices that emulates a hardware RAID device. A software RAID combines partitioned space from multiple physical devices into a single virtual device that you manage like any device. Each member device contributes an equal amount of space to the RAID. You can create partitions, pools, and volumes on a RAID device, just as you would with any physical storage device. Unlike hardware RAID devices, software RAIDs use standard host adapters and do not require any special RAID hardware.

The following table describes the software RAID devices supported by NSS:

Table 14-1 *RAID Characteristics*

Type of RAID	Number of Segments	Purpose	Advantages	Disadvantages
RAID 0	2 to 14	Data striping	Improves I/O performance for both reads and writes, which occur concurrently in parallel to its member devices.	Does not provide data redundancy for data fault tolerance. If a single disk fails, the data cannot be recovered. You must re-create the RAID 0 and restore its volumes from a backup copy before you can use it again.
RAID 1	2 to 4	Data mirroring	Provides full data redundancy for failover and instant recovery. Improves read performance. Equivalent write performance is possible with a duplex connection, which provides a separate channel for each member disk.	To achieve the best I/O performance, it requires separate channels for each member disk; otherwise, write performance decreases slightly. Each mirror must be on a separate device; it can share no disks in common. Can be a member of only one pool.
RAID 5	3 to 14	Data striping with parity	Provides limited data recovery for one member disk at a time. If a single drive in the RAID fails, its volumes and pools remain active, but with degraded performance because the RAID must use parity to reconstruct the missing data. You must remove the failed segment, replace the disk, add the new segment, and restripe the data to reconstruct the data on the replacement drive. Improves read performance if all drives are present and working properly. If a drive fails, read performance is reduced because of parity reads and data reconstruction.	Read responses are the same only if data happens to be in cache when called; otherwise it is slightly reduced for parity checking. I/O performance for writes is reduced because it takes time to calculate and write parity to disk. The more writes to the drive, the greater is the burden to CPU. If multiple disks fail, the data cannot be recovered. You must re-create the RAID 5 and restore its volumes from a backup copy before you can use it again.

Type of RAID	Number of Segments	Purpose	Advantages	Disadvantages
RAID 0+1	2 to 4 RAID 0 devices	Mirroring RAID 0 devices	Provides full data redundancy for failover and instant recovery. Improves I/O performance for both reads and writes, but is slower than an unmirrored RAID 0 device.	Requires separate channels for each member disk to achieve best I/O performance. RAID 0 devices that you mirror can share no disks in common. If a single disk fails, you must re-create the RAID 0 and remirror the entire device. The data is restored through mirroring.
RAID 5+1	2 to 4 RAID 5 devices	Mirroring RAID 5 devices	Provides full data redundancy for failover and instant recovery. If a single data disk fails, the RAID 5 device remains up and mirrored. Its performance is degraded until you replace the failed disk. It can handle multiple disk failures, depending on the number of failures and which disks fail.	Requires separate channels for each member disk to achieve best I/O performance. RAID 5 devices that you mirror can share no disks in common. If multiple data disks fail concurrently on the same segment, you must remove the damaged segment from the mirror, re-create the RAID 5, and then mirror the RAID 5. The data synchronizes with the mirrors.

14.2 Planning for a Software RAID Device

Before you create your software RAID device, you must evaluate your storage requirements and determine which RAID solution best fits your performance and fault tolerance needs.

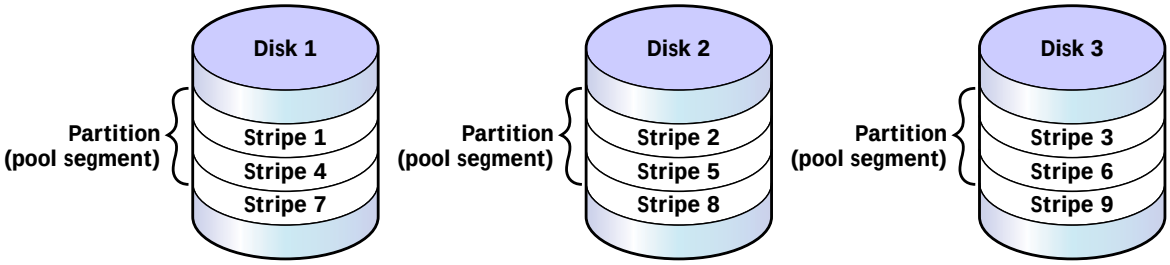
- Section 14.2.1, “General Guidelines for Software RAID Devices,” on page 186
- Section 14.2.2, “Guidelines for Software RAID 1 Devices,” on page 186
- Section 14.2.3, “Drive Restrictions for NSS Software RAID 0, 1 and 5 Devices,” on page 187
- Section 14.2.4, “Choosing a Software RAID Solution,” on page 187
- Section 14.2.5, “Determining the Partition Size,” on page 188
- Section 14.2.6, “Determining the Number of Partitions,” on page 189
- Section 14.2.7, “Determining the Stripe Size for RAID 0 and RAID 5,” on page 189

14.2.1 General Guidelines for Software RAID Devices

To set up a RAID device, you allocate free space from any of your physical storage devices. NSS transparently presents the allocated free space as virtual partitions that represent NSS-managed physical partition areas on the participating drives. These partitions are the basic elements of a software RAID device. How you allocate each of the partitions to pools depends on the nature of the pools (shared or not shared for clustering) and the type of RAID device it is.

As an example, the RAID 0 device, illustrated in the following figure, consists of three RAID partitions. It stripes data across three physical drives. The stripes are written and read in the order designated.

Figure 14-1 *Striping Data on a Software RAID 0 Device*



Consider the following general guidelines when creating a software RAID device:

- Each partition in the RAID configuration should come from a different device. NSS lets you obtain RAID partitions from the same device, but this severely impedes the performance of your file system.
- Do not use space from a drive that contains your system partition (such as the root (/) or `/boot` partitions).
- You can use any combination of IDE or SCSI devices in a software RAID device. Make sure these devices have similar performance characteristics; otherwise, your performance might decrease.
- In a clustered solution using OES Cluster Services, for software RAIDs on shared disks:
  - You can have only one pool associated with that RAID device.
  - You must create an NSS pool and volume on that RAID device from the same server node before the pool can be migrated to other nodes in the cluster.

14.2.2 Guidelines for Software RAID 1 Devices

The following is a list of requirements for mirroring partitions with software RAID 1 devices:

- Mirrored partitions must have the same partition type: NSS partitions to NSS partitions and Traditional partitions to Traditional partitions.
- Mirrored partitions should be set up on devices that have similar performance thresholds.
- You can mirror only partitions, each from its own OES partition. If a storage pool spans multiple devices, each of the individual partitions that make up that pool can be mirrored independently. All of the pool's partitions must be mirrored in order for the data in that pool to be fault tolerant.

- You cannot combine mirror groups (existing groups with multiple mirrored partitions). A mirror group is expanded by adding a partition from your free space but not by adding an existing mirror group to the current group.
- All of the devices that participate in a mirror must be marked a shared or not shared for clustering for each mirror group.
- Avoid setting up multiple mirror groups on a single device. Such configuration heavily degrades the performance of the file system.
- To mirror software RAID 0 devices, the member devices must have no drives in common.

14.2.3 Drive Restrictions for NSS Software RAID 0, 1 and 5 Devices

When you create or expand an NSS software RAID device, do not use space from the drive that contains your boot partition or system partition. In a worst-case scenario, you might need to reinitialize a drive if the partition in the RAID failed.

WARNING: Reinitializing a drive destroys its contents.

14.2.4 Choosing a Software RAID Solution

When choosing a software RAID solution, determine whether you need to address file system performance, data fault tolerance, or both. The following table highlights the key data fault tolerance, performance, and configuration issues associated with each RAID type.

NOTE: Using iSCSI devices on the iSCSI initiator server to create NSS software RAID5 devices can cause poor performance. If you would like RAID5 protection, create the RAID5 on the target server and present that RAID device to the initiator as a single iSCSI device.

Table 14-2 *RAID Performance Characteristics*

Requirement	RAID 0	RAID 1	RAID 5	RAID 0+1	RAID 5+1
NSS	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only
Data fault-tolerance	No	Redundancy	Parity	Redundancy	Redundancy and parity
Read I/O performance	Best improved (parallel reads)	Improved if parallel channels to each mirror	Improved, if all segments are present and working properly	Improved, with RAID 0 read advantage	Improved if parallel channels to each mirror, with RAID 5 read advantage

Requirement	RAID 0	RAID 1	RAID 5	RAID 0+1	RAID 5+1
Write I/O performance	Best improved (parallel writes)	Same if parallel channels; otherwise, slightly decreased	Somewhat decreased by parity calculation	Slightly improved, depending on channel configuration	Somewhat decreased, depending on channel configuration and parity calculations
Valid names For more information on guidelines, see Section 6.4, “Naming NSS Storage Objects,” on page 64.	2 to 15 characters (NSSMU) 2 to 58 characters (iManager)	2 to 15 characters (NSSMU) 2 to 58 characters (iManager)	2 to 15 characters (NSSMU) 2 to 58 characters (iManager)	2 to 15 characters (NSSMU) 2 to 58 characters (iManager)	2 to 15 characters (NSSMU) 2 to 58 characters (iManager)
Number of segments	2 to 14	2 to 4	3 to 14	Mirror 2 to 4 software RAID 0 devices	Mirror 2 to 4 software RAID 5 devices
Maximum RAID size (total for combined segments)	2 TB	2 TB	2 TB	2 TB	2 TB
Maximum segment size	1 TB, if 2 segments	2 TB for each mirror	0.66 TB, if 3 segments	2 TB for each mirror	0.66 TB, if 3 segments
Minimum segment size	12 MB	12 MB	12 MB	12 MB	12 MB

NOTE: The Maximum segment size and Maximum RAID size values correspond only to DOS partitioned devices. If all devices are using GPT, the size limits are removed. Since pools are currently limited to 8TB, RAID1 sizes for pool objects are also limited to 8TB.

14.2.5 Determining the Partition Size

The space that a member device contributes to a software RAID is called a partition or segment. Each physical device should contribute only one partition to the RAID; otherwise, it negates the benefits of the RAID. A software RAID device can contain only one partition per device. All member partitions in a software RAID device must be of the same size.

If any one device that you use to create a software RAID is partitioned using the DOS partition table scheme, a RAID segment size can be only up to 2TB (where 1 TB = 2E40 bytes). This is necessary because all segments of a RAID must be of the same size. If all devices are using GPT, a RAID segment size can be more than 2 TB. Since pools are currently limited to 8TB, RAID1 sizes for pool objects are also limited to 8TB.

The capacity of the RAID device depends on the RAID type and the number of member partitions:

- **RAID 0:** Capacity equals the number of partitions times the partition size.
- **RAID 1:** Capacity equals one partition size.
- **RAID 5:** Capacity equals the number of partitions minus one, times the partition size.
- **RAID 0+1:** Capacity equals one partition size of space taken from the RAID 0; it is not limited to the partition size of partitions in the RAID 0 itself.
- **RAID 5+1:** Capacity equals one partition size of space taken from the RAID 5; it is not limited to the partition size of partitions in the RAID 5 itself.

14.2.6 Determining the Number of Partitions

Each software RAID device comprises multiple partitions. You must specify at least the minimum number of partitions to create the type of RAID you choose. The maximum number of partitions is limited by the maximum number supported by that RAID type and the maximum device size that can be seen by NSS and Traditional file systems.

After you set up the software RAID device, you can increase its size by adding segments. In iManager, click **Storage > Software RAIDs > Increase Size**, and then add segments up to the maximum number of segments for each type of RAID.

You cannot remove segments in a RAID device to decrease its size. In general, to reduce the size of a RAID device: Back up its data, delete the RAID, re-create the RAID with a smaller segment size or fewer segments, and then restore its data from the backup copy.

For some RAIDs, you can replace a failed partition by removing the segment from the RAID, replacing the failed disk, and then adding a segment to the RAID to replace the failed one. For information, see Section 14.15, “Replacing a Failed Segment in a Software RAID,” on page 202.

14.2.7 Determining the Stripe Size for RAID 0 and RAID 5

In RAID 0 and RAID 5 configurations, NSS writes data to each member device in turn. The maximum amount of data (in KB) committed to each write to a partition is called a stripe. Striping is unrelated to file block sizes that you might set on your storage device.

Set the stripe size in increments of powers of two, between 4 KB and 256 KB (4, 16, 32, 64, 128, 256). The default stripe size is 64 KB.

To maximize performance of the RAID, set the stripe size to correspond with your typical data write requirements. In general, use smaller stripe sizes for data servers and medium-to-large sizes for file servers. For most implementations, 64 KB provides the best performance.

14.3 Viewing a List of Software RAID Devices on a Server

Use the Software RAIDs task in the iManager Storage plug-in to create and manage your software RAID devices.

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

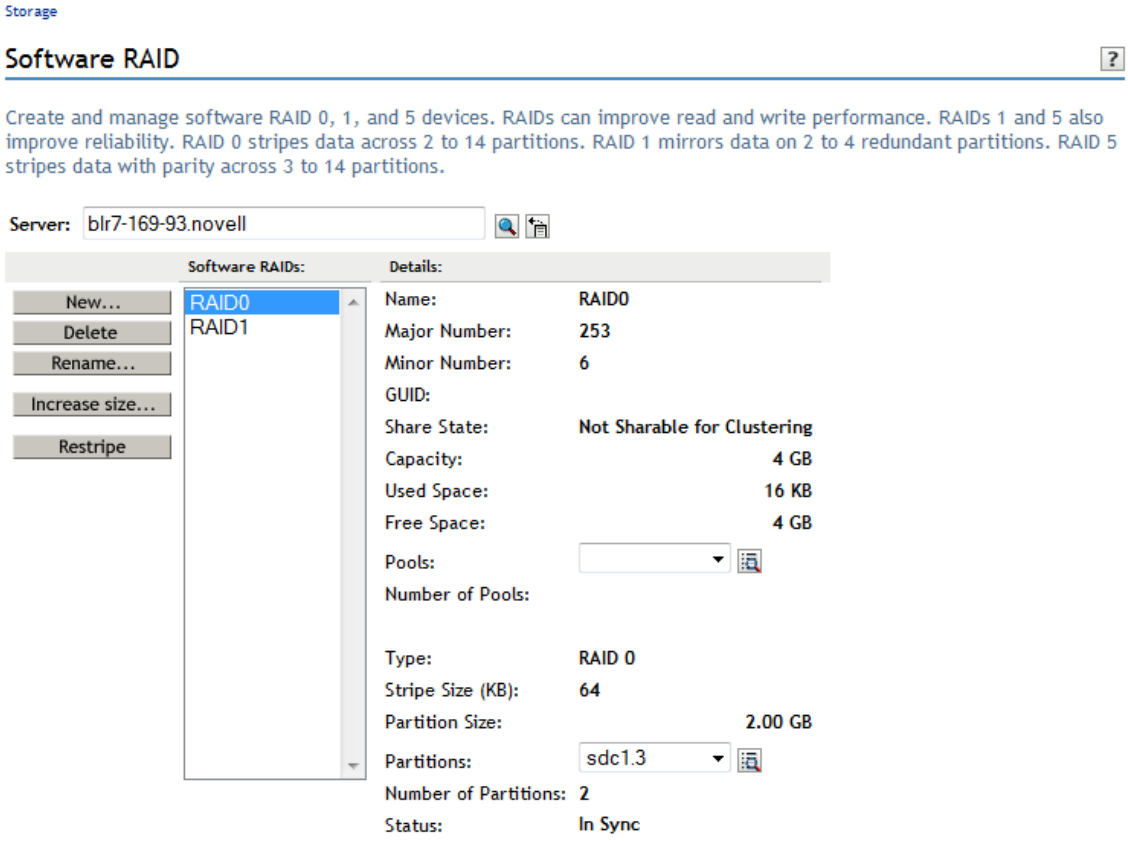
2 Select a server in the NetIQ eDirectory tree where you are logged in.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

A list of software RAID devices appears in the **Software RAIDs** list. Depending on the number of devices, this can take a few seconds. Avoid clicking again in the page until it refreshes and displays the **Software RAIDs** list.

3 Select a RAID device from the **Software RAIDs** list to view its details.

For an overview of the subtasks available from this page, see “Software RAIDs” on page 104.


Storage
Software RAID
Create and manage software RAID 0, 1, and 5 devices. RAIDs can improve read and write performance. RAIDs 1 and 5 also improve reliability. RAID 0 stripes data across 2 to 14 partitions. RAID 1 mirrors data on 2 to 4 redundant partitions. RAID 5 stripes data with parity across 3 to 14 partitions.
Server: blr7-169-93.novell
Software RAIDs:
Details:
New...
Delete
Rename...
Increase size...
Restripe
RAID0
RAID1
Name: RAID0
Major Number: 253
Minor Number: 6
GUID:
Share State: Not Sharable for Clustering
Capacity: 4 GB
Used Space: 16 KB
Free Space: 4 GB
Pools:
Number of Pools:
Type: RAID 0
Stripe Size (KB): 64
Partition Size: 2.00 GB
Partitions: sdc1.3
Number of Partitions: 2
Status: In Sync

14.4 Viewing Details of a Software RAID Device

You can view the following information about a selected software RAID device:

Table 14-3 *Explanation of Details for a Software RAID Device*

Software RAID Device Detail	Description
Name	The administrator-specified descriptive name for the RAID. In iManager, if you do not specify a name for the device at create time, a name is autogenerated in the format of RAID <type> Device <number>.

Software RAID Device Detail	Description
Major Number Minor Number	The device identity in major:minor format. Major and minor numbers are associated with the device special files in the /dev directory and are used by the operating system to determine the actual driver and device to be accessed by the user-level request for the special device file.
GUID	The Global Unique Identifier number that NSS assigns to the storage object. This number is necessary so your file system can locate the specific device.
Share State	**Shareable for Clustering** or **Not Shareable for Clustering**. The share state can be modified on the Devices page. If you assign partitions to a software RAID device, all the devices for those member partitions must either be marked as **Shareable for Clustering**, or all marked as **Not Shareable for Clustering**.
Capacity	The total storage capacity of the device that is reserved for data storage. For a RAID 0, the storage capacity is equal to the sum of its partitions. For RAID 1, the storage capacity is equal to a single partition size; the duplicate partitions are mirrors. For RAID 5, the storage capacity is equal to the sum of its partitions minus one partition for parity.
Used Space	The amount of space on the device that is currently in use by NSS partitions.
Free Space	The total amount of space on the device that is currently not in use.
Pools	The drop-down list shows all pools that exist on this device. To view a pool's details or to manage a pool, select the pool from the list, then click the **View Details** icon to go to the **Pools** page for that pool. **NOTE:** Shared RAID 0, RAID 5 or RAID 1 would have only one pool associated with it.
Number of Pools	The total number of pools that use this device. **NOTE:** Shared RAID 0, RAID 5 or RAID 1 would have only one pool associated with it.
Type	The type of RAID (such as RAID 0, RAID 1, RAID 5).
Stripe Size	The maximum size (in KB) of a data write, as configured for a RAID 0 or RAID 5 device.
Partition Size	The size (in MB) of partitioned space per drive.
Partitions	Lists the member partitions of the selected software RAID device in a drop-down list. To view a partition's details, select the partition in the drop-down list, then click the **View Details** icon.
Number of Partitions	The total number of partitions in the selected software RAID device.

Software RAID Device Detail	Description
Status	Shows the status of a RAID 1 (mirrored) device's partitions: ◆ **In Sync:** The mirror group is fully synchronized. ◆ **Out of Sync:** The mirror group is only partially synchronized, and the percent mirroring in progress. ◆ **Not Mirrored:** The device is not mirrored (only one partition).

Viewing Details in iManager

1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

   This opens the **Software RAIDs Management** page.

   The **Software RAIDs** list displays the virtual RAID devices on the selected server. The list might include any RAID O, RAID 1, or RAID 5 devices that you created. It does not list any hardware RAID devices in this list.
3. Select a virtual storage device in the **Software RAIDs** list to view information about that device, then wait for the page to refresh.

Viewing Details in NSSMU

1. In NSSMU, select **Software RAIDs**.
2. Select the RAID device you want to manage and wait for the information to be displayed.

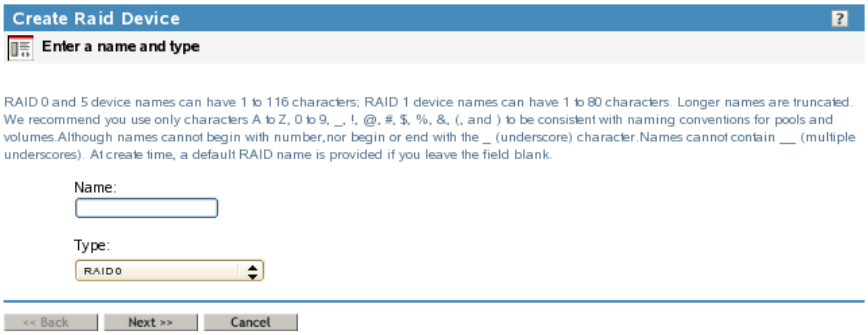
14.5 Creating Software RAID Devices with iManager

1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.
3. Click New.

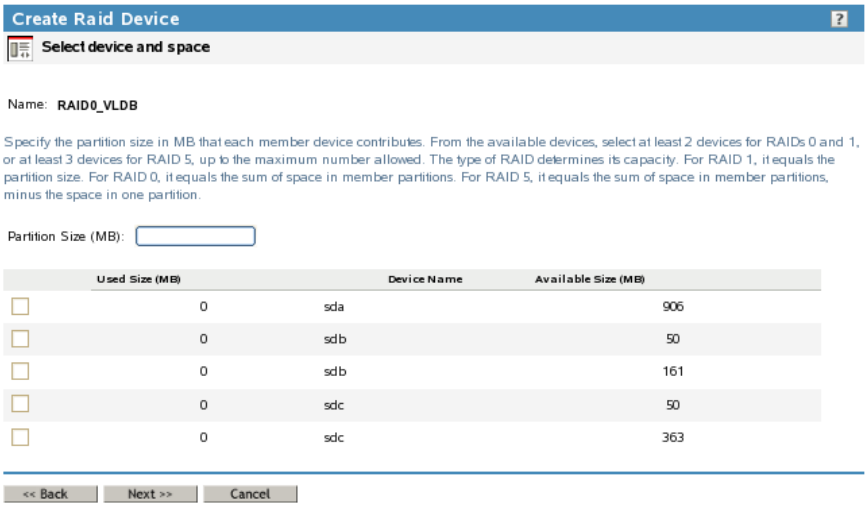
   This opens a Wizard that steps you through the process.


Create Raid Device
Enter a name and type
RAID 0 and 5 device names can have 1 to 116 characters; RAID 1 device names can have 1 to 80 characters. Longer names are truncated. We recommend you use only characters A to Z, 0 to 9, _, !, @, #, $, %, &, (, and) to be consistent with naming conventions for pools and volumes.Although names cannot begin with number,nor begin or end with the _ (underscore) character.Names cannot contain __ (multiple underscores). At create time, a default RAID name is provided if you leave the field blank.
Name:
Type:
RAID0
<< Back
Next >>
Cancel

4 **Device Type and Name:** Specify the type of RAID device you want to create, type a name for the RAID device, then click **Next**.

If you leave the Name field blank, NSS creates a unique name for the device in the form of RAID <type> Device <sequential_number>. For information about choosing names, see Section 6.4, “Naming NSS Storage Objects,” on page 64.

This opens the **Devices and Space** page.


Create Raid Device
Select device and space
Name: RAID0_VLDB
Specify the partition size in MB that each member device contributes. From the available devices, select at least 2 devices for RAIDs 0 and 1, or at least 3 devices for RAID 5, up to the maximum number allowed. The type of RAID determines its capacity. For RAID 1, it equals the partition size. For RAID 0, it equals the sum of space in member partitions. For RAID 5, it equals the sum of space in member partitions, minus the space in one partition.
Partition Size (MB):
Used Size (MB)
Device Name
Available Size (MB)
0 sda 906
0 sdb 50
0 sdb 161
0 sdc 50
0 sdc 363
<< Back
Next >>
Cancel

5 **Devices and Space:** Select devices and the amount of space to use from each, then click **Next**.

5a In the **Partition Size** field, type the amount of space in MB to use from each physical device.

NSS identifies devices that have enough free space to meet the partition-size requirements and are eligible for inclusion in the RAID. For information, see “Determining the Partition Size” on page 188.

If the amount you specify exceeds the amount of free space available on a minimum number of physical devices, the RAID creation fails and returns an error message.

5b Select the check box next to each of the storage devices you want to obtain space from.

You can obtain space from multiple devices. Select only devices that have enough space available to meet your needs. Each segment must be more than 12 MB. If any segment uses space from a device that is partitioned with the DOS partition table scheme, then the maximum segment size must be less than 2 TB. If all devices are using GPT, a RAID segment size can be more than 2 TB. Because pools are currently limited to 8 TB, RAID 1 sizes for pool objects are also limited to 8 TB.

If a device's available space is smaller than the specified partition size, it is disabled (dimmed) so that you cannot select it.

IMPORTANT: Unallocated partitions (that is, partitions that are not mirrored and do not contain pools or other file systems), are deleted in order to present the unused space as free space for use by the RAID. No data loss occurs by this action.

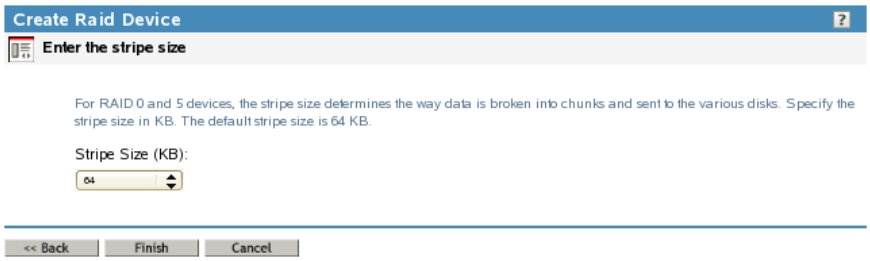
A single physical device can offer multiple free space areas in the list. After you select a device, all other free space on that device is disabled for that RAID. Each device should contribute only one partition to the RAID; otherwise, it defeats the purpose of improved performance and data protection that a RAID affords.

If the server has both local and shared devices, the partitions of a RAID can reside only on shared devices or only on local devices. If you select the check box next to a local storage device, the shared devices are dimmed so that you cannot select them. If you select the box next to a shared storage device, the local devices are dimmed.

Only devices that have free space appear in the list. If no devices are listed, there is no space available to create a software RAID device. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the **Software RAIDs** page to create a RAID device.

5c If this is a RAID 0 or 5, click **Next** to go to the Stripe Size page. Otherwise, skip ahead to Step 7.

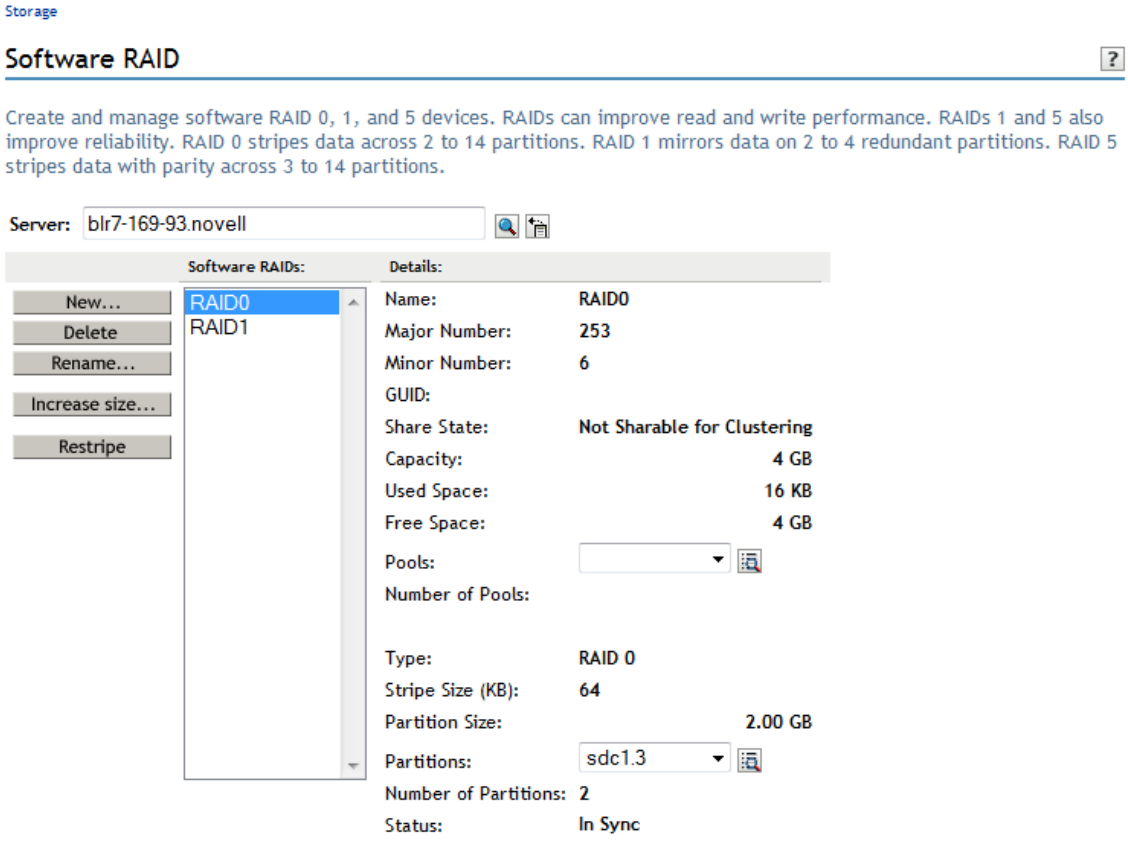
This opens the Stripe Size page.


Create Raid Device
Enter the stripe size
For RAID 0 and 5 devices, the stripe size determines the way data is broken into chunks and sent to the various disks. Specify the stripe size in KB. The default stripe size is 64 KB.
Stripe Size (KB):
64
<< Back
Finish
Cancel

6 Stripe Size: If this is a RAID 0 or 5 device, set the stripe size. For information, see "Determining the Stripe Size for RAID 0 and RAID 5" on page 189.

7 Click **Finish**. (Or click **Cancel** at any time to back out of the process.)

NSS creates the software RAID device, then opens to the Software RAIDs task. Your newly created RAID device appears in the **Software RAID Devices** list. The name you provided for the RAID appears in the Description field. This is the device name displayed when the RAID is listed in the NSSMU Software RAIDs page.


Storage
Software RAID
Create and manage software RAID 0, 1, and 5 devices. RAIDs can improve read and write performance. RAIDs 1 and 5 also improve reliability. RAID 0 stripes data across 2 to 14 partitions. RAID 1 mirrors data on 2 to 14 redundant partitions. RAID 5 stripes data with parity across 3 to 14 partitions.
Server: blr7-169-93.novell
Software RAIDs:
Details:
New...
Delete
Rename...
Increase size...
Restripe
RAID0
RAID1
Name: RAID0
Major Number: 253
Minor Number: 6
GUID:
Share State: Not Sharable for Clustering
Capacity: 4 GB
Used Space: 16 KB
Free Space: 4 GB
Pools:
Number of Pools:
Type: RAID 0
Stripe Size (KB): 64
Partition Size: 2.00 GB
Partitions: sdc1.3
Number of Partitions: 2
Status: In Sync

After you create the RAID, manage it as you would a physical device in terms of using it for pools and volumes. For information on configuring an NSS file system on your RAID, see Chapter 16, “Managing NSS Pools,” on page 211.

14.6 Creating Software RAID Devices with NSSMU

1. In NSSMU, select **RAID Devices** from the NSSMU main menu.
2. Press Insert (Ins) to create a new device.
3. Select the RAID type (0, 1, or 5), then press Enter.
4. (Conditional) If this is a RAID 0 or 5 device, specify the stripe size, then press Enter.

   The default stripe size is 64 KB, which typically provides the best performance for devices with NSS volumes.
5. Use the arrow keys to select the partitions that you want to contribute space to the RAID.

   If no partitions appear, it is an indication that either there are no partitions large enough or there are no free partitions. Each segment must be more than 12 MB. If any segment uses space from a device that is partitioned with the DOS partition table scheme, then the maximum

segment size must be less than 2 TB. If all devices are using GPT, a RAID segment size can be more than 2 TB. Since pools are currently limited to 8TB, RAID1 sizes for pool objects are also limited to 8TB.

IMPORTANT: Unallocated partitions (that is, partitions that are not mirrored and do not contain pools or other file systems), are deleted in order to present the unused space as free space for use by the RAID. No data loss occurs by this action.

After space is selected from a device, other free space associated with that device might not appear. This prevents you from adding more than one segment from a single physical device, and consequently, helps ensure the optimum performance of your file system.

The following table lists the number of segments that you can include in a RAID device:

RAID Type	Number of Segments
RAID 0	Minimum of 2 and a maximum of 14
RAID 1	Maximum of 4
RAID 5	Minimum of 3 and a maximum of 14; one segment is used for parity

6 Specify the amount of space to use, then press Enter.

The segment is created and added to the **Segments Included** in the RAID window.

14.7 Mirroring an Existing Pool with NSSMU

1 Before you begin, review the Section 14.2.2, “Guidelines for Software RAID 1 Devices,” on page 186.

2 In NSSMU, select **Partitions** from the NSSMU main menu.

3 From the list of existing partitions, select the NSS partition for the pool you want to mirror.

4 Press **F3** to create the RAID 1 device and mirror the partition where the pool resides.

5 From the available devices, select up to three additional devices that you want to use as a segment, then press Enter.

On the page where you select the second partition, you have to press the space bar to select the partition for the second mirror. When it is truly selected, the asterisk next to it stays there even if you move up and down in the list. Then press **F3** to mirror. The message pops up to confirm creating the mirror.

The space assigned is the same size as the existing partition. The segments must reside on different devices. If no partitions appear, it is an indication that either there are no partitions large enough or no free space exists on other devices.

6 To confirm the RAID 1 device, select **RAID Devices** from the NSSMU **Main** menu. The RAID 1 device ID appears in the **RAID Devices** window.

7 Select the RAID device, then view its details to make sure that synchronization has begun.

The remirroring status shows a percentage is greater than 0. It is fully synchronized at 100%If you are mirroring a shared partition (that is, if it contains a cluster-enabled pool), the synchronization to the mirror does not begin automatically. Continue with Step 8a.

8 If you are mirroring a shared partition (that is, if it contains a cluster-enabled pool), start the remirroring manually by doing the following:

8a Use one of the following methods to initiate mirroring for the newly created mirror:

- At the server console of a cluster node, enter the following to migrate the cluster resource to another node:

  ```
  cluster migrate cluster_resource destination_node_name
  ```

  Migrating the pool causes load scripts to be executed and causes the mirroring to start on the new node.

- At the server console of the cluster node where the pool is currently active, enter

  ```
  dmsetup message raid_device_name 0 remirror=on
  ```

  WARNING: Issue this command only on the node where the pool is currently active. Issuing the command on multiple nodes can corrupt the mirror.

8b Verify that the remirroring has begun by opening NSSMU on the node where the pool is currently active, open the RAID page, then select the RAID device.

The remirroring status shows a percentage is greater than 0. It is fully synchronized at 100%.

14.8 Recovering a Mirror where All Elements Report 'Not in Sync' Using NSSMU

If all elements of a mirrored RAID report a status of "not in sync", use the following procedure to recover the mirror.

1 Determine which element you believe to be the in-sync element.

2 Log in to the server as the root user, and open a terminal console.

3 Launch nssmu.

4 From the NSSMU menu, select Software RAIDs.

5 In the list of RAIDs, select the RAID, then press Enter to see its elements.

6 Remove all of the elements from the mirror except the element you want to keep. Select the element to delete, then press Delete. Repeat this step for each of the elements you want to remove from the Software RAID. Wait for the segment to be removed before you remove the next segment.

When you are done, you have a RAID1 device that consists of the single element that you believed to be the in-sync element.

7 Force the single RAID element to be in sync. On the Software RAIDS page, select the RAID device, then press F6 (Restripe).

8 Add elements back into the mirror as desired.

8a On the Software RAIDs page, select the RAID device and press F3 (Expand).

8b From the list of available devices, select the device or devices that you want to add.

8c Press F3 (Accept).

14.9 Creating a RAID 1 Mirror to Duplicate Data

You can create a RAID 1 mirror to duplicate data on a new device, such as to duplicate data on a new storage array.

1. Set up the RAID 1 mirror between the initial storage element and new storage element.

   For information, see Section 14.5, “Creating Software RAID Devices with iManager,” on page 192.

2. Let the RAID create a duplicate of the data on the mirror.
3. (Optional) If you want to retain the data on the initial storage element and use the element elsewhere, remove the disk it is on from the server.

   WARNING: If you leave the disk attached to the server while deleting the element from the RAID, its data is destroyed.

   ---

4. Use NSSMU or iManager to delete the initial storage element from the mirror, leaving only the new storage element active on the server as a single-element mirror.

   The RAID 1 group remains in Media Manager and uses only 1 KB of memory. The new array performs normally, without performance degradation and without consuming additional resources.

   WARNING: Leave the RAID 1 group active because deleting the RAID 1 group deletes all of its member partitions and destroys the data on them.

   In iManager and from the command line, the new array reports that it is Not Mirrored. In NSSMU, the new array reports that it is In-Sync and 100% remirrored, even though there is only a single element.

14.10 Creating a Software RAID 0+1 with NSSMU

In NSS, you can mirror your software RAID 0 devices to create a nested RAID 0+1 device. Use NSSMU to mirror the partition used by the pool on a RAID 0 device. The following procedure describes how to create the RAID 0+1 in NSSMU. You can also create the RAID 0 devices first in iManager, but you must use NSSMU to be able to select them for a mirror.

1. In NSSMU, create a software RAID 0 device with 2 to 14 segments.

   For information, see Section 14.6, “Creating Software RAID Devices with NSSMU,” on page 195.

2. Repeat Step 1 one to three times to create 2 to 4 RAID 0 devices.

   The RAID 0 devices you use to create the mirror must have no drives in common. Each drive you use to create the RAIDs can belong to only one of the RAID 0 devices.

3. In NSSMU, create a pool on one of the RAID 0 devices.

   3a In NSSMU, select **Pools** from the NSSMU main menu.

   3b Press **Insert** (Ins) to create a pool.

   3c From the list of available devices, select one of the RAID 0 devices.

   3d Assign all of the available space to the pool, then press Enter.

4 Create a RAID 1 device to mirror the pool.

4a In NSSMU, select **Partitions** from the NSSMU main menu.

4b Select the NSS partition for the pool you want to mirror.

4c Press **F3** to create the RAID 1 device and mirror the partition.

4d From the available devices, select up to three remaining RAID 0 devices you created above.

4e Press **F3** to initialize and create the RAID 1 (mirror) device.

After the RAID device is created, the device ID appears in the **RAID Devices** window. This window is viewed from the RAID Devices NSSMU main menu. The RAID is a RAID 0+1.

14.11 Creating a Software RAID 5+1 with NSSMU

In NSS, you can mirror your software RAID 5 devices for your server to create a nested RAID 5+1 device. Use NSSMU to mirror the partition used by the pool on a RAID 5 device. The following procedure describes how to create the RAID 5+1 in NSSMU. You can also create the RAID 5 devices and NSS pool for the RAID 5 devices in the Storage plug-in for iManager, and then switch to NSSMU to mirror the pool's partition.

1 In NSSMU, create a software RAID 5 device with 3 to 14 segments.

For information, see Section 14.6, "Creating Software RAID Devices with NSSMU," on page 195.

2 Repeat Step 1 one to three times to create 2 to 4 RAID 5 devices.

The RAID 5 devices you use to create the mirror must have no drives in common. Each drive you use to create the RAIDs can belong to only one of the RAID 5 devices.

3 In NSSMU, create a pool on one of the RAID 5 devices.

3a In NSSMU, select **Pools** from the NSSMU main menu.

3b Press Insert (Ins) to create a pool.

3c From the list of available devices, select one of the RAID 5 devices.

3d Assign all of the available space to the pool, then press Enter.

4 Create a RAID 1 device to mirror the pool.

4a In NSSMU, select **Partitions** from the NSSMU main menu.

4b Select the NSS partition for the pool you want to mirror.

4c Press **F3** to create the RAID 1 device and mirror the partition.

4d From the available devices, select one of the remaining RAID 5 devices you created above.

NOTE: You can select up to three devices.

4e Press **F3** to initialize and create the RAID 1 (mirror) device.

After the RAID device is created, the device ID appears in the **RAID Devices** window. This window is viewed from the RAID Devices NSSMU main menu. The RAID is a RAID 5+1.

14.12 Renaming a Software RAID Device

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server in the eDirectory tree where you are logged in.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 Click **Rename**.

This opens a dialog box where you can enter the new name.

4 Type the new name.

Do not leave the field blank when you are renaming because a default RAID name is not generated for a rename procedure. For information about choosing names, see Section 6.4, “Naming NSS Storage Objects,” on page 64.

5 Click **Finish**. (Or click **Cancel** at any time to back out of the process.)

NSS renames the software RAID device, then opens to the Software RAIDs Page. The details for the renamed software RAID device are displayed on the page, with the new name in the Description field.

14.13 Increasing the Size of a Software RAID Device

You can increase the capacity of an existing software RAID 0, 1 or 5 device by adding partitions, up to the maximum number for the type of RAID. You cannot modify the size of an individual partition after the device is created.

IMPORTANT: If the software RAID device is shared in a cluster, connect to the node where the RAID is currently active to manage the RAID and increase the size of the RAID.

To add partitions to an existing software RAID:

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server in the eDirectory tree where you are logged in.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.

3a Click **Volumes**.

3b Select the volumes in the RAID device you want to expand.

3c Click **Dismount**.

4 Select a device in the **Software RAID Device**s list.

If the device contains the maximum number of partitions, the **Increase Size** option is dimmed. You cannot expand the RAID. Do not proceed.

5 Click **Increase Size**.

This opens the Expand a RAID Wizard to let you choose from available free space on devices that are not already members in the RAID and that contain enough free space to meet the RAID’s current partition size.

6 Do one of the following:

- If there are no devices available, you cannot expand the RAID. Click **Cancel**.

A device must be the same size or larger than the segment size being used in the RAID. You might need to add or initialize a new device, then try again.

- Select the check box next to each of the storage devices you want to obtain space from.

  The partition size is predetermined by the existing RAID. The partition you choose must be the same size as other partitions comprising the device.

  Stripe size is fixed at its current value for the duration of the expansion. If you want to change the stripe size, restripe after the expansion.

  You can choose multiple partitions up to the maximum for the type of RAID it is. For information, see "Determining the Number of Partitions" on page 189 and "Determining the Partition Size" on page 188.

7 Click **Finish**.

After you add a partition, the RAID's data is restriped across both existing and new partitions. During the restriping, the RAID's capacity does not include the added partition. While restriping, the new device is considered a failed device until it is completely resynchronized. After the restriping is complete, the RAID's capacity includes the added partition.

While expanding a RAID 5 device, if one of the drives goes down (either one of the existing segments or the newly added segment), the pool deactivates. If you remove any device from a RAID 5 other than the one that was just added for restripe, it considers that as a two-disk error, and deactivates the RAID and the pool.

Remirroring and Restriping Temporarily Impacts System Performance

For software RAID 1 devices, the additional mirror begins to collect data immediately. Performance is slightly impacted, but data is available.

For software RAID 0 or RAID 5 devices, the system automatically begins restriping the disks to accommodate the partition you just added. This severely impacts performance until the striping is complete. The capacity of the RAID is not updated until the restriping is done. If the restriping process is interrupted before it completes, it begins automatically on system reboot.

14.14 Restriping a Software RAID

In general, there are three reasons for restriping of software RAID 0 and 5 devices:

- **Partition Replacement:** If a partition fails, you must replace it. Restriping can recover the data in a single lost partition in a RAID 5 by using parity. However, the data must be restriped from a backup tape if a partition fails in a RAID 0.
- **RAID Expansion:** If you expand a RAID 0 or 5 device, the RAID restripes the data across all members.
- **RAID Stripe Size:** If you increase or decrease the stripe size of a RAID 0 or 5 device, the RAID restripes the data across all members. This happens infrequently, unless you are measuring performance with different striping sizes to determine which best fits your operational needs.

If the restriping process is interrupted, the RAID recognizes that when the system reboots, and automatically continues the restriping process. You can also use iManager to pause and resume a restriping process.

IMPORTANT: If the RAID is on a shared system and no NSS pool is on it, it will not restart automatically after a reboot. In this case, the RAID must be enabled using the `nlvm raid enable <raid_name>` command. Ensure that the RAID device is enabled on one node only. Carelessly enabling a RAID device can lead to corruption.

When expanding a RAID 5, if the newly added drive goes down during the restripe, the restriping continues without the new partition and puts the RAID in a degraded state with one partition missing. If the same partition comes back online, it finishes the restripe. If the partition has completely failed, after the degraded restriping is complete, you can add a new replacement partition, and the RAID restripes to fix it.

To manually resume or pause the Restripe process:

1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.
   - **3a** Click **Volumes**.
   - **3b** Select the volumes in the RAID device you want to expand.
   - **3c** Click **Dismount**.
4. Select a device in the **Software RAIDs** list.

   Wait for the page to refresh before continuing.
5. Click **Restripe**.

   The restriping process begins or pauses immediately. Restriping severely degrades I/O performance until the restriping is complete.

14.15 Replacing a Failed Segment in a Software RAID

For some RAIDs, you can replace a failed segment by removing the segment from the RAID, replacing the failed disk, and then adding a segment to the RAID to replace the failed one. The following table provides recommended actions for each RAID type.

Table 14-4 *Recommended Actions on Segment Failure in a Software RAID*

Software RAID	Remove Segments	Recommended Action
RAID 0	Not allowed	If one or more disks in a RAID 0 fails, all data is lost on that device. You must re-create the RAID and restore its data from a backup copy.

Software RAID	Remove Segments	Recommended Action
RAID 1	All but one mirrored segment	The last segment of a RAID 1 device is the primary device that contains the data. You can use the NSSMU **Partitions** option to remove mirrored segments to free up the related space on those segments, but the data on the last remaining segment is no longer mirrored. If a disk fails in one of the segments, all of its data is lost on that segment. The remaining mirrors continue to operate normally. Remove the segment, replace the failed disk, and then add the segment as an element in the mirror. The data is synchronized over time until it is fully mirrored on the new segment.
RAID 5	One data segment at a time	You can temporarily remove one segment at a time in a RAID 5 device to replace a failed data disk. For example, you can replace a single failed data disk while the system is still operational. Use the NSSMU **Partitions** option to remove the failed segment, replace the failed disk, add a segment to the RAID 5, and then restripe the RAID. The parity is used during restriping to restore the missing data. Read and write performance is degraded on the failed segment until the data is recovered because of parity-related reads and calculations. If multiple data segments fail concurrently, all data is lost on that device. You must delete the RAID 5 and re-create it with good disks. Recover its data from a backup copy. For example, if a second segment fails before the restriping is completed for the first drive replacement, this is considered a two-drive failure. You must recover data from a backup copy.
RAID 0+1	All but one mirrored segment; cannot remove disks from the underlying RAID 0	The last segment of a RAID 0+1 is a RAID 0 device that contains the original data. If one or more disk fails in one of the mirrored segments, all data is lost on that segment. The remaining mirrors continue to operate normally. Remove the failed RAID 0 from the RAID 0+1. Delete the RAID 0, replace the failed disks, re-create the RAID 0, and then add the RAID 0 segment as an element in the mirror. The data is synchronized over time until it is fully mirrored on the repaired RAID 0 segment.
RAID 5+1	All but one mirrored segment; can safely remove one segment at a time per segment	The last segment of a RAID 5+1 is a RAID 5 device that contains the original data. If a single data segment fails in a RAID 5 that is an element in a RAID 5+1, repair the RAID 5 while it is operational, as you would with any RAID 5. If multiple disks in a mirrored segment fail concurrently, all data is lost on that segment. The remaining mirrors continue to operate normally. Remove the failed RAID 5 from the RAID 5+1. Delete the RAID 5, replace the failed disks, re-create the RAID 5, and then add the repaired RAID 5 as a segment in the RAID 5+1. The data is synchronized over time until it is fully mirrored on the repaired RAID 5 segment.

A Segment Fails in a RAID 0

If a segment fails in a RAID 0, you must delete the software RAID 0 device, create a new RAID 0 device, then copy your data to the RAID from backup media. For information, see Section 14.16, “Deleting a Software RAID Device,” on page 205.

A Segment Fails in a RAID 1

1. From the command console, enter `nssmu`.
2. From the NSSMU main menu, select **Software RAIDs**.
3. Remove the bad segment.
   - **3a** Select the software RAID 1 device that you want to manage.
   - **3b** Press Enter to show its member segments. The bad segment should show a status of Bad - Unavailable Partition.
   - **3c** Select the bad segment, then press **Delete**.
4. Expand the RAID with a replacement segment.
   - **4a** Select the software RAID 1 device that you want to manage.
   - **4b** Press **F3** to increase the size of the RAID.
   - **4c** From the list of available devices, select the device you want to use for the new segment. The segment size defaults to the size of existing partitions in the RAID 1.
   - **4d** Select **OK** twice.
5. The data begins mirroring automatically and continues until the segment is 100% mirrored.

A Single Data Segment Fails in a RAID 5

To replace a single failed data segment in a software RAID 5:

1. From the command console, enter `nssmu`.
2. From the NSSMU main menu, select **Software RAIDs**.
3. Remove the bad segment.
   - **3a** Select the software RAID 5 device that you want to manage.
   - **3b** Press **Enter** to show its member segments. The bad segment should show a status of Bad - Unavailable Partition.
   - **3c** Select the bad segment, then press **Delete**.
4. Expand the RAID with a replacement segment.
   - **4a** Select the software RAID 5 device that you want to manage.
   - **4b** Press **F3** to increase the size of the RAID.
   - **4c** From the list of available devices, select the device you want to use for the new segment. The partition size defaults to the size of existing partitions in the RAID 5.
   - **4d** Select **OK** twice.
5. The restriping should begin automatically. If it does not, from the **Software RAIDs** page, select the RAID 5 device, then press **F6** to restripe.

Multiple Segments Fail in a RAID 5

If two or more segments fail concurrently in a RAID 5 or if the parity partition fails, you must delete the software RAID 5 device, create a new RAID 5 device, then copy your data to the RAID from backup media. For information, see Section 14.16, “Deleting a Software RAID Device,” on page 205.

14.16 Deleting a Software RAID Device

If you delete a software RAID device, it ends the RAID relationship, and it destroys the NSS file structure on member partitions. All data is lost. Make sure to back up your data or move it to another location before deleting the software RAID device.

IMPORTANT: Deleting a single-segmented NSS RAID1 device which is part of a NSS pool from iManager deletes the pool and all underlying partitions of the pool. To delete such a RAID1 device and attach the segment directly to the pool, use NSSMU.

NOTE: Only the RAID1 device gets deleted and no data is lost under the following scenarios:

- When the RAID1 device has only one segment and if the device is consumed by a pool, deleting the RAID1 device deletes only the device. The segment is directly attached to the pool.
- When the RAID1 device has only one segment and if the device is an SBD mirror, deleting the RAID1 device deletes only the mirror. The mirror's segment becomes the SBD partition.

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1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.
   - **3a** Click **Volumes**.
   - **3b** Select the volumes in the RAID device you want to delete.
   - **3c** Click **Dismount**.
4. Select a device in the **Software RAIDs** list.
5. Click **Delete**.

14.17 Viewing Pools on a Software RAID Device

1. In iManager, click **Storage > Software RAIDs**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

   A list of devices appears in the **Software RAIDs** list.
3. In the **Software RAIDs** list, select a RAID device.
4. In the **Details** area, click the arrow on the **Pools** drop-down list to expand it.

5 Select a pool, then click **View Details**.

This opens the **Pools** page where you can view the details of the pool and manage it. See Section 16.2, “Creating a Pool,” on page 212 for a sample **Pools** page.

For information about pool management, see “Managing NSS Pools” on page 211.

14.18 Viewing Partitions on a Software RAID Device

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Software RAIDs** list, select a device.

Wait for the page to refresh before continuing.

4 In the **Details** area, click the arrow on the **Partitions** drop-down list to expand it.

5 To view information about partitions, click the **Partitions View Details** icon.

This opens the **Partitions** page. It displays a list of all the partitions that currently exist on the selected device.

6 Select a partition from the **Partitions** list, then click **Details** to view its details.

14.19 Deleting Partitions on a Software RAID Device

You can delete all but one partition of a RAID 1 (mirror) and only one partition at a time for a RAID 5. To delete a RAID 1 partition, you must delete its RAID.

1 In iManager, click **Storage > Software RAIDs**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.

3a Click **Volumes**.

3b Select the volumes in the RAID device pool.

3c Click **Dismount**.

4 In the **Software RAIDs** list, select a device.

Wait for the page to refresh before continuing.

5 Click the **Partitions View Details** icon.

This opens the **Partition** page. It displays a list of all the partitions that currently exist on the selected device.

6 Select a partition from the **Partitions** list, click **Delete**, then click **OK**.

14.20 Managing Software RAID Devices with NSSMU

You can use different keystrokes that enable you to view, expand, restripe, create, and delete a RAID device using NSSMU. For more information, see Table 10-11 on page 109.

15 Managing Multipath I/O to Devices

OES Storage Services for Linux does not provide multipath I/O (MPIO) support. This section describes how to use Linux tools to configure and manage multipathing for devices, and how to configure Linux multipathed devices for use with NSS.

- Section 15.1, “Understanding Multipath I/O,” on page 209
- Section 15.2, “NSS Errors When Linux Multipath Is Not Configured,” on page 210
- Section 15.3, “Configuring Multipath,” on page 210

15.1 Understanding Multipath I/O

Multipath I/O software resolves multiple paths to a device into a single device and manages the traffic flow across the paths transparently for file systems on the devices. NSS on Linux does not provide an LVM-based software solution for managing multiple paths like the Media Manager multipath solution on NetWare. Instead, you can use Linux multipath I/O tools to configure and manage multiple paths for devices where you want to create NSS software RAIDs, pools, and volumes. You can also use solutions from the storage array vendor or third-party vendor.

Devices have multiple connection paths when you implement hardware configurations such as the following:

- The server has multiple host bus adapters for connection to external devices.
- The external storage device has multiple interconnects for connection to one or more host bus adapters.
- A server with multiple host bus adapters is connected to a storage device through intermediate devices, such as a Fibre Channel SAN switch.

In a Linux host, when there are multiple paths to a storage controller, each path appears as a separate block device, which results in multiple block devices for single LUN. The Device Mapper Multipath utility detects multiple paths with the same LUN WWID, and creates a new multipath device with that WWID.

For example, a host with two HBAs attached to a storage controller with two ports via a single unzoned Fibre Channel switch sees four block devices:

```
/dev/sdb
/dev/sdc
/dev/sdd
/dev/sde
```

Device Mapper Multipath creates a single block device, `/dev/mpath/mpath1` that reroutes I/O through those four underlying block devices.

15.2 NSS Errors When Linux Multipath Is Not Configured

If you have not started multipathing before you attempt to configure NSS pools or volumes, NSS cannot resolve the multiple paths and attempts the command on all the paths. You get the following error:

```
Error 21621: zERR_MSAP_POOL_ALREADY_IN_USE.
```

After you have configured Linux multipathing for a device, the multipath device appears in NSSMU or iManager.

15.3 Configuring Multipath

For detailed information about configuring and managing multipath I/O for devices, see Managing Multipath I/O for Devices (https://www.suse.com/documentation/sles-12/stor_admin/data/cha_multipath.html) in the SLES 12: Storage Administration Guide (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).

For information about using Linux multipath solutions with clustered pool resources on OES Cluster Services, see "Multipath I/O Configuration Requirements" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

16 Managing NSS Pools

OES Storage Services uses storage pools to efficiently acquire and use all free space available on devices. A pool is an area of storage that consists of space, called a partition, obtained from one or more of the storage devices available on a server. The amount of space that each storage device contributes can differ for each member device.

Use the iManager Storage plug-in to configure and manage NSS pools. For information about iManager, see Section 10.1, “iManager and Storage-Related Plug-Ins,” on page 93.

You can also use the console-based NSS Management Utility to configure and manage NSS pools. For information, see Section 10.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 108.

For information about installing OES Cluster Services and cluster-enabling shared NSS pools in the OES Cluster Services clusters, see “Configuring and Managing Cluster Resources for Shared NSS Pools and Volumes” in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*. For OES 2 SP3 to OES 2018 SP2 upgrades, see “Requirements and Guidelines for Upgrading Clusters from OES 2 SP3” in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*. For NetWare 6.5 SP8 to OES 2018 SP2, see “Managing File Systems in Mixed-Mode Clusters” in the *OES 2015 SP1: Novell Cluster Services NetWare to Linux Conversion Guide*.

This section describes how to configure and manage NSS pools by completing the following tasks:

- Section 16.1, “Guidelines for Creating a Pool,” on page 212
- Section 16.2, “Creating a Pool,” on page 212
- Section 16.3, “Activating and Deactivating Pools,” on page 217
- Section 16.4, “Increasing the Size of a Pool,” on page 218
- Section 16.5, “Renaming a Pool,” on page 219
- Section 16.6, “Deleting a Pool,” on page 220
- Section 16.7, “Managing Fstrim on a Pool,” on page 221
- Section 16.8, “Viewing Pools on a Server,” on page 221
- Section 16.9, “Viewing Pool Details,” on page 221
- Section 16.10, “Viewing Partition Information for a Pool,” on page 223
- Section 16.11, “Viewing Volume Information for a Pool,” on page 224
- Section 16.12, “Viewing Device Information for a Pool,” on page 224
- Section 16.13, “Moving a Pool,” on page 224
- Section 16.14, “Preventing Pools from Activating on Multiple Servers,” on page 225
- Section 16.15, “Updating eDirectory Pool Objects,” on page 230
- Section 16.16, “Updating eDirectory for Shared Pool,” on page 230
- Section 16.17, “What’s Next,” on page 232

16.1 Guidelines for Creating a Pool

Devices must be initialized before any space is shown as available for creating a pool. Without initializing the devices, no space will be shown available for pool creation. For instructions, see Section 11.5, “Initializing a Disk,” on page 132.

OES NCP Server must be installed, configured, and running. For information, see Section 6.6.1, “NCP,” on page 72.

OES CIFS must be installed, configured, and running before you can use the CIFS option when cluster-enabling an NSS pool. For information, see Section 6.6.3, “OES CIFS,” on page 73.

OES AFP must be installed, configured, and running before you can use the AFP option when cluster-enabling an NSS pool. For information, see Section 6.6.2, “OES AFP,” on page 73.

16.2 Creating a Pool

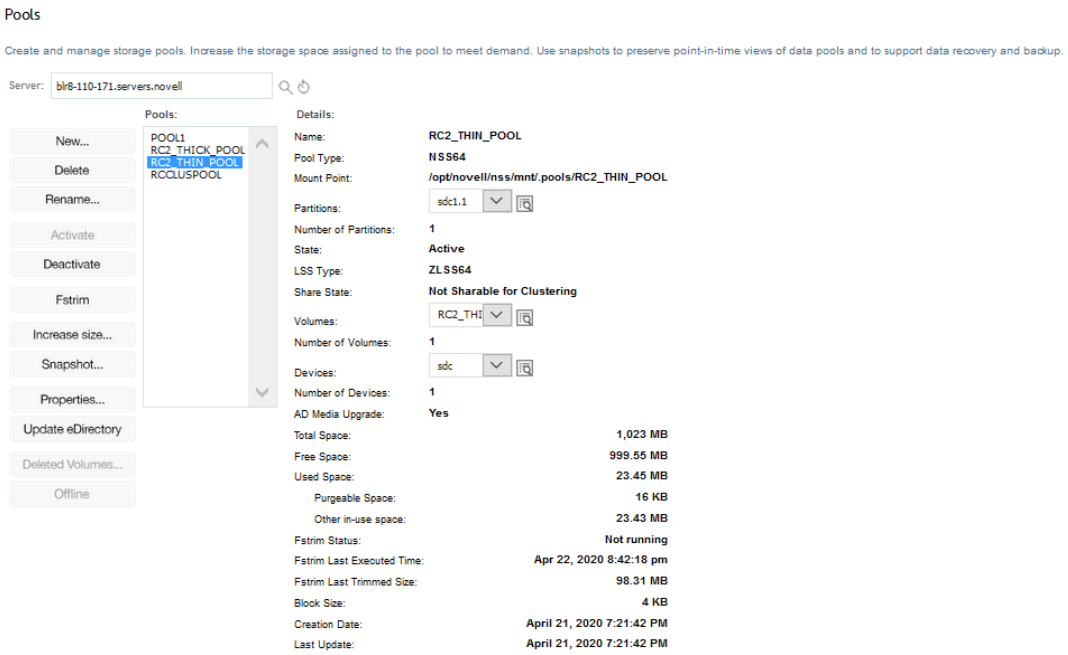
1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

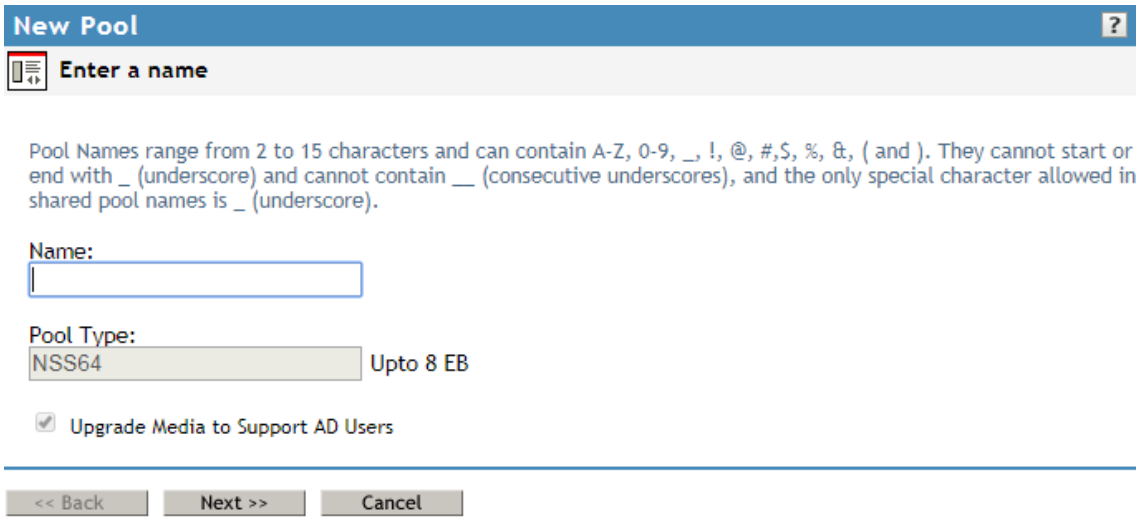
For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

A list of pools appears in the **Pools** list.



3 To create a new pool, click **New**.

The New Pool Wizard opens to guide you through the process.


New Pool
Enter a name
Pool Names range from 2 to 15 characters and can contain A-Z, 0-9, _, !, @, #,$, %, &, (and). They cannot start or end with _ (underscore) and cannot contain __ (consecutive underscores), and the only special character allowed in shared pool names is _ (underscore).
Name:
Pool Type:
NSS64
Upto 8 EB
Upgrade Media to Support AD Users
<< Back
Next >>
Cancel

4 Specify a name for the new storage pool, then click **Next**.

NSS supports only NSS64 pool type. NSS64 pools use 64-bit block addressing and supports upto 8 EB (exabyte) of pool size. All NSS64-bit pools are by default AD media upgraded.

For guidelines about naming pools, see Section 6.4, “Naming NSS Storage Objects,” on page 64.

In the following example, the device is not shared, so the **Cluster Enable on Creation** check box is not displayed.

5 Specify device parameters and the space to use, then click **Next**.

5a Select the check box next to one or more of the available devices you want to use in the pool.

5b In **Used Size**, specify the amount of space in megabytes (MB) to add to the pool from each device you selected, up to the amount of free space available for that device.

To update the **Total Pool Size** as you enter the device’s **Used Size**, click anywhere within the Wizard dialog box. If any entry exceeds a device’s available space, the pool expansion fails and returns an error message. When expanding a pool, the devices that have at least 1 MB of free space is displayed in the list because NSS pools can only be expanded on a MB boundary.

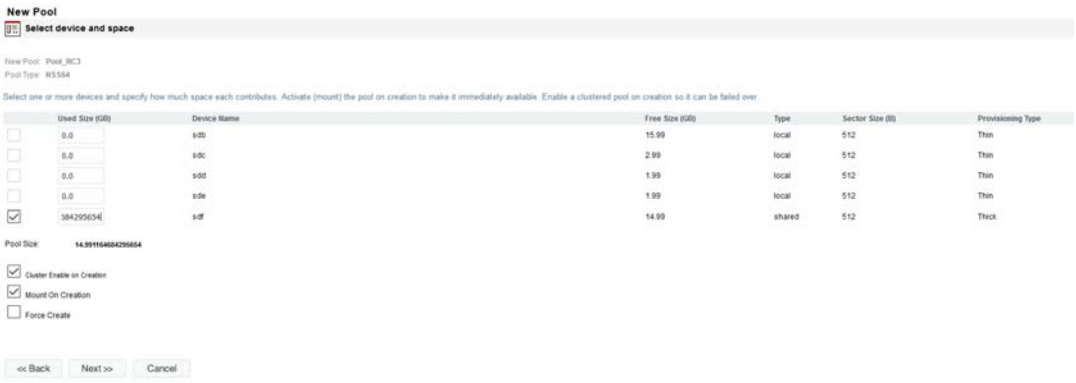
The pool can be up to 8 EB.

You can obtain space from one or more of the devices listed. Only devices that have free space appear in the list. If no devices are listed, it might be because you need to initialize a recently added device, or it might be that there is no space available on any devices. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the **Pools** page to increase the size of this pool.

5c Select **Activate on Creation** (**Mount on Creation** for Linux) to activate (mount) the device automatically after it is created.

This parameter is automatically enabled. Deselect the check box to turn it off.

5d If the selected device is shareable, the **Cluster Enable on Creation** check box is automatically selected so the pool can be shared in a cluster configuration. Deselect the check box if you do not want to cluster-enable this pool for sharing.



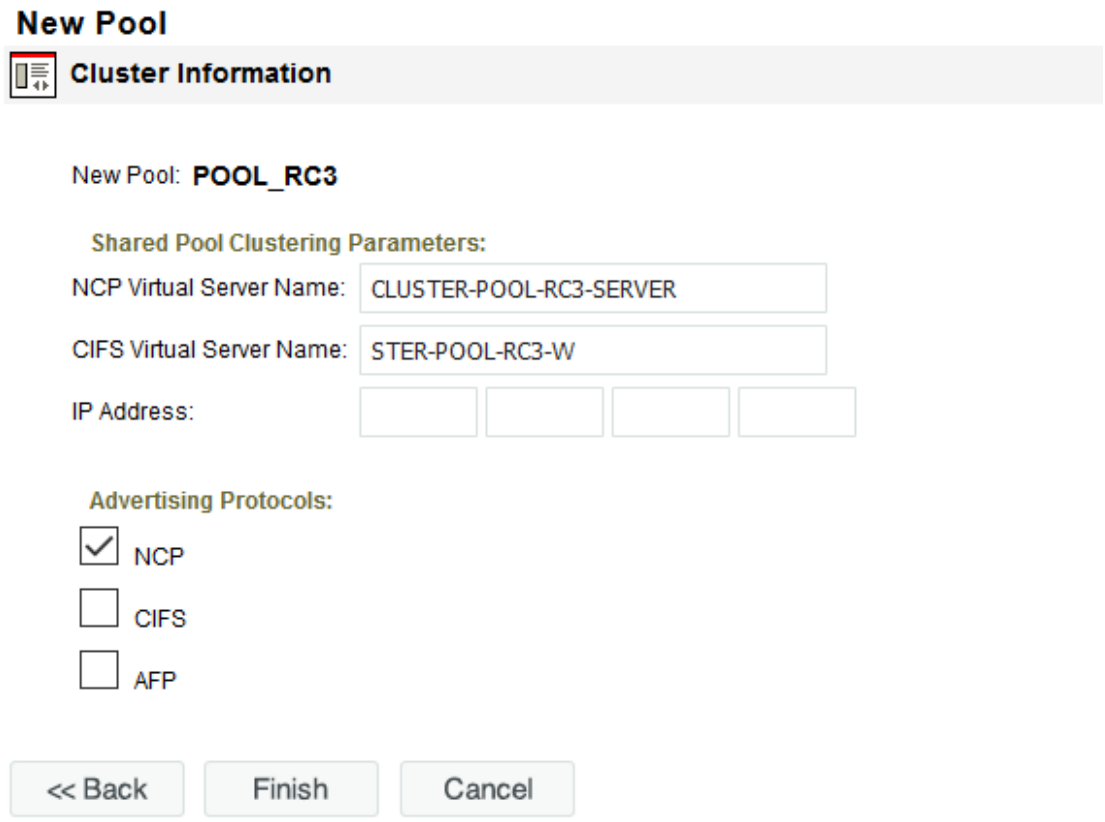
5e If the pool is cluster-enabled, click **Next** to specify its cluster parameters. Otherwise, skip ahead to Step 7.

5f Select **Force Create**, when you are creating a shared cluster pool that is media upgraded to support AD users, all cluster nodes from where the pool may be accessed must be upgraded to OES 2015 or later. If you have a mixed cluster node environment, where all your cluster nodes are not on OES 2015 or later, select the Force Create check box to force the pool creation. This shared cluster pool cannot be loaded on nodes earlier than OES 2015.

IMPORTANT: If all nodes in the cluster are not upgraded to OES 2015 or later, the pool will not load in cluster nodes older than OES 2015. As a workaround, configure preferred nodes for each media-upgraded cluster resource so that these resources load on OES 2015 or later nodes. For more information on "Configuring Preferred Nodes and Node Failover Order for a Resource", see the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

---

6 If the **Cluster Enable on Creation** check box is selected, an additional page appears that allows you to specify the cluster information.



Specify the following shared pool clustering parameters:

- **NCP Virtual Server Name:** The name assigned to the virtual server that represents the shared pool in the cluster.

  When you cluster-enable a pool, a virtual Server object is automatically created in NetIQ eDirectory and given the name of the Cluster object plus the name of the cluster-enabled pool. For example, if the cluster name is `cluster1` and the cluster-enabled pool name is `pool1`, then the default virtual server name will be `cluster1_pool1_server`. You can edit the field to change the default virtual server name.

- **CIFS Virtual Server Name:** The name assigned to the virtual server for handling CIFS (Common Internet File System) requests. This is the name of the server as it appears in a Windows system. For CIFS Virtual Server Name, the maximum supported character length is 15.

  NOTE: If the NCP Virtual Server Name is less than or equal to 15 characters and CIFS check-box is enabled under the **Advertising Protocols**, the CIFS Virtual Server Name is auto-populated with the same name as NCP Virtual Server Name. You can edit the field to change the CIFS virtual server name.

- **IP Address:** The IP address that you want to assign the virtual server.

Each cluster-enabled NSS pool requires its own IP address. The IP address is used to provide access and failover capability to the cluster-enabled pool (virtual server). The IP address you assign to the pool remains assigned to the pool regardless of which server in the cluster is accessing the pool.

IMPORTANT: The IP address for the virtual server must be in the same IP subnet as the server nodes in the cluster where you plan to use it.

To specify an IP address, tab between the different entries; no dot is required in the fields. For example, if the IP address is `192.168.1.1`, type the following:

```
192 168 1 1
```

- **Advertising Protocols:** Protocols that give users native file access to data.

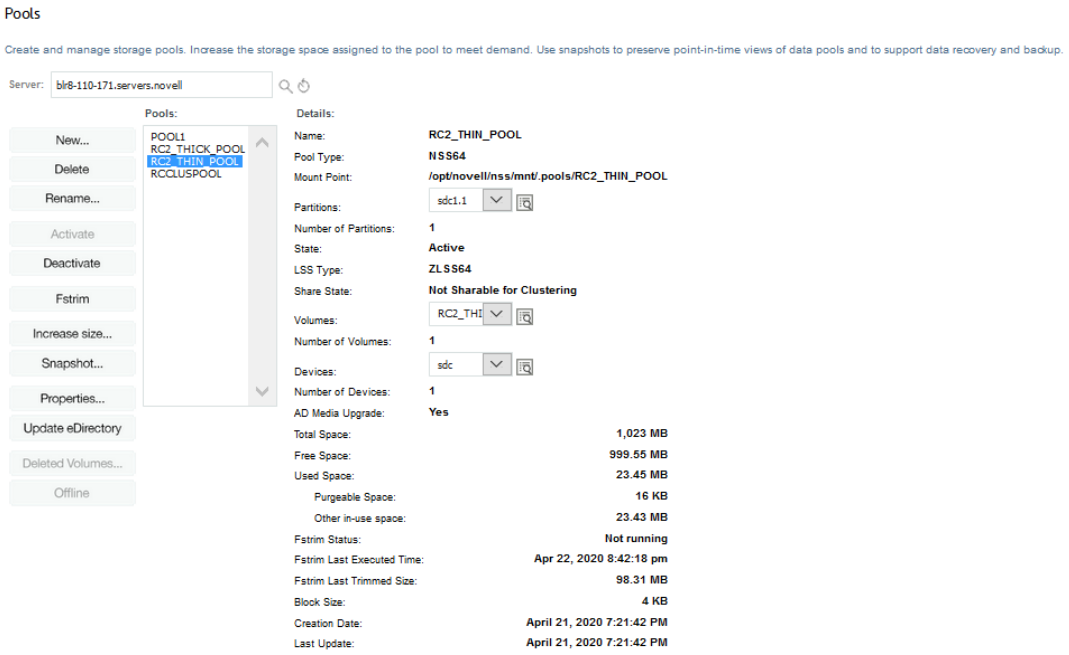
  Specify one or more advertising protocols by selecting the check boxes of the protocols you want to enable for data requests to this shared pool.

  NOTE: For OES 2 and earlier, OES CIFS and OES AFP are not available. CIFS and AFP check boxes can be selected, but CIFS and AFP functionality does not apply to Linux. Selecting the check boxes has no effect.

  - NetWare Core Protocol (NCP) is the OES networking protocol used by the Client for Open Enterprise Server. It is selected by default. Selecting NCP causes commands to be added to the pool-resource load and unload scripts to activate the NCP protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to Clients for Open Enterprise Server.
  - CIFS is the Windows networking protocol. Selecting CIFS causes commands to be added to the pool-resource load and unload scripts to activate the CIFS protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to CIFS clients.
  - Apple Filing Protocol (AFP) is the Macintosh networking protocol. Selecting AFP causes commands to be added to the pool-resource load and unload scripts to activate the AFP protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to AFP clients.

7 Click **Finish**.

For NSS, the create time might take longer than expected. Typically, the pool creation takes less than a minute, and the volume creation takes less than 10 seconds. However, if you have a large tree or the server does not hold an eDirectory replica, the create time can take up to 3 minutes.



8 Create a volume on the pool. For information, see Section 19.3, “Creating Unencrypted NSS Volumes,” on page 268 or Section 20.3, “Creating an Encrypted Volume,” on page 296.

16.3 Activating and Deactivating Pools

You might need to temporarily restrict user access to an pool. Instead of bringing down the server, you only need to deactivate the specific pool.

The **Activate** option on the **Pools** page makes the selected pools and all the volumes in them available for user access. The **Deactivate** option on the **Pools** page takes the selected pools and all the volumes in them temporarily unavailable to users. It does not destroy volumes in the pools, nor does it destroy the data contained in the volumes.

To change the state of a pool:

1 In iManager, **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Pools** list, select the pool that you want to activate or deactivate.

Wait for the page to refresh. It displays the pool’s details and enables management options. The State field shows whether the device is Active or Deactive.

4 Depending on the pool's current state, to change the state of the pool:

- Click **Actions > Activate**.
- Click **Deactivate > Actions**.

16.4 Increasing the Size of a Pool

Using the **Increase Size** option on the **Pools** page expands the storage capacity of a selected pool by adding new partitions. You can increase the size of your storage pools, but you cannot reduce their size.

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

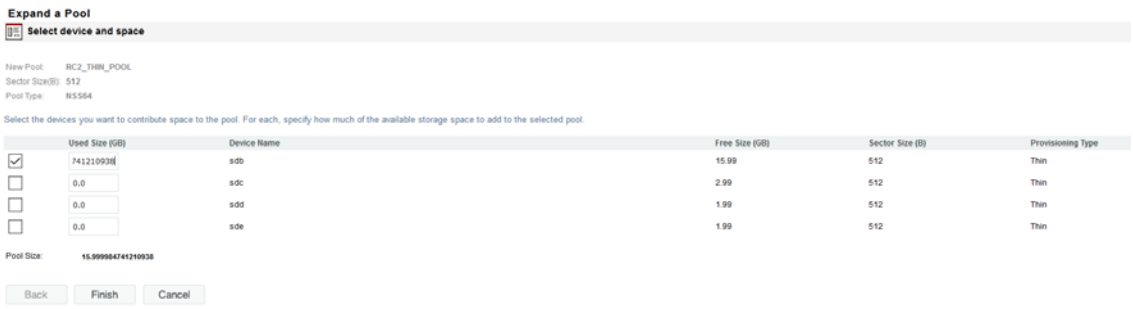
For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3 In the **Pools** list, select the pool that you want to expand.

Wait for the page to refresh. It displays the pools's details and enables management options.

4 Click **Increase Size**.

This opens an **Expand a Pool** Wizard that guides you through the process of adding partitions from available devices.



5 Select the devices you want to use and the amount of space to use from each device.

In the **Used Space** field, type the amount of space in megabytes (MB) to add, up to the amount of free space available for that device. If any entry exceeds a device's available space, the pool expansion fails and returns an error message.

Software RAID 1 (mirrored) devices can contain only one pool per device. If you select a RAID 1 device to add a partition to your pool, NSS automatically allocates all of the available space to the pool.

The **Total Pool Size** is the sum of the partitions you define plus the current pool size. Initially, the **Total Pool Size** field displays the current size of the pool. To update the **Total Pool Size** as you enter values in the **Used Size** field, click anywhere within the Wizard dialog box.

You can obtain space from one or more of the devices listed. Only devices that have free space appear in the list. If no devices are listed, there is no space available to increase the size of the pool. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the **Pools** page to increase the size of this pool.

6 Click **Finish**, or click **Cancel** at any time to back out of the process.

16.5 Renaming a Pool

The **Rename** option on the **Pools** page lets you to modify the name of the selected pool. For example, you might want to assign a pool name that relates to a department name change. The pool must be in the active state when you rename the pool so that eDirectory can be updated.

For an NSS pool, NLVM must unload and reload the pool in order to rename it. Depending on the pool's load-time behavior and share state, the pool might be in a deactive state after the rename and require administrator action to reload the pool and its volumes. Because the volumes are temporarily unavailable, it is best to perform a pool rename during a period of little or no user activity. See Table 16-1 to determine what actions to take after renaming a pool:

Table 16-1 *Actions Required after Renaming an NSS Pool*

Pool Share State	Pool Load-Time State	Pool State After a Rename	Action Required
Unshared	Autoloaded	Active with volumes dismounted	Mount the pool's volumes
Unshared	Not autoloaded	Deactive	Activate the pool, then mount its volumes
Shared	Load and unload is controlled by OES Cluster Services. Before you rename a cluster-enabled pool, make sure to offline the pool resource, activate the pool by using iManager or NSSMU instead of using the load script, then you can rename the pool by using iManager or NSSMU.	Deactive	Online the pool resource to activate the pool and its volumes. OES Cluster Services automatically updates the pool resource load and unload scripts to reflect the name change. Also, NSS automatically changes the Pool Resource object name in eDirectory.

Because renaming involves changing information in the Pool object in eDirectory, you must ensure that the shared pool is active on a cluster node that has its NCP server object in the same context as the Pool object of the pool you are going to rename.

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3 In the **Pools** list, select the pool that you want to rename.

Wait for the page to refresh and display the details.

4 If the pool is deactive, activate it by clicking Activate.

Wait for the page to refresh and display the details.

5 Click **Rename**.

This opens the **Rename a Pool** Wizard that guides you through the process.

6 Specify a name, then click **Finish**.

If the name is valid and unique, the pool is successfully renamed.

If not, you receive an error, and you must repeat the process. For information about valid pool names, see Section 6.4, “Naming NSS Storage Objects,” on page 64.

7 If the **Pools** page does not automatically update to show the new name for the pool, in **Roles and Tasks**, click **Pools** to refresh the current page.

8 Activate the pool if it is deactive, then mount the pools’s volumes.

16.6 Deleting a Pool

You might need to delete an NSS pool to create more free space for other pools. The **Delete** option on the **Pools** page removes one or more selected pools from the server, including all member partitions and the data on them. Deleting a pool removes the ownership of the space it occupied, freeing the space for reassignment. If the pools you want to delete are active, deactivate them before you delete them.

WARNING: Deleting a pool destroys all the volumes and data in it. These volumes cannot be restored.

If the pool is created on RAID1 device, deleting the pool will also delete the RAID1 device.

- Section 16.6.1, “Prerequisites for Deleting a Pool,” on page 220
- Section 16.6.2, “Procedure,” on page 220

16.6.1 Prerequisites for Deleting a Pool

If the pool is shared in a OES Cluster Services cluster, you must offline the cluster resource before you attempt to delete the clustered pool or its cluster resource.

If the pool has pool snapshots, you must delete the pool snapshots before you delete the pool. For information, see Section 18.10, “Deleting a Pool Snapshot,” on page 259.

16.6.2 Procedure

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Pools** list, select one or more pools that you want to delete.

Wait for the page to refresh. It displays the pools's details and enables its management options.

4 Click **Delete**.

5 Click **Yes** to confirm the deletion, or click **No** to cancel the deletion.

WARNING: If you click **Yes**, the pool and all the volumes and data on it are immediately destroyed.

16.7 Managing Fstrim on a Pool

Using the **Fstrim** option on the **Pools** page you can trim the unused blocks on the selected NSS pool. This process runs in the background. For more information on the trimmed size in bytes, see **fstrim Last Trimmed Size** on the **Pools Details** area of the **Pools** page display information about a selected pool. You can also view the fstrim status information at `/var/log/messages`.

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3 In the **Pools** list, select the pool on which fstrim has to be executed.

4 Click **Fstrim**. A pop-up message is displayed. Click **OK** to continue.

The fstrim request is submitted successfully.

5 Click **OK** to return to iManager welcome page or click **Repeat Task** to return to Pools page.

16.8 Viewing Pools on a Server

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

When the page refreshes, a list of pools appears in the **Pools** list. Depending on the number of pools, this can take a few seconds. Avoid clicking again in the page until it refreshes and displays the **Pools** list.

16.9 Viewing Pool Details

The **Pool Details** area of the **Pools** page displays information about a selected pool in the **Pools** list, as described in the following table:

Table 16-2 *Explanation of Pool Details*

Device Detail	Description
Name	The descriptive pool name assigned by the administrator.

Device Detail	Description
Pool Type	Specifies the type of pool. NSS supports only the NSS64 pool type. NSS64 pools use 64-bit block addressing and supports upto 8 EB (exabyte).
Mount Point	On your Linux system, this is the mount location for the NSS pool. The default mount location is `/opt/novell/nss/mnt/.pools/poolname`, where *poolname* is the name of the selected pool.
Partitions	A list of all of the partitions that are part of the selected pool. To view information about any of the partitions, select the partition in the drop-down list, then click the **View Details** icon.
Number of Partitions	The total number of partitions currently assigned to the selected pool.
State	The current state of the selected pool, as Active or Deactive. Active pools are available to the users; deactive pools are not available to users.
LSS Type	The type of Loadable Storage System, such as ZLSS, CDDVD, or DOSFAT.
Share State	Shows whether the selected pool is on a device that is marked as **Shareable for Clustering** or as **Not Shareable for Clustering**. The system pool cannot reside on a device that is shareable for clustering. Use the Devices page to set this device attribute.
Volumes	A list of all existing volumes residing in the selected pool. To view information about any of the volumes or to manage any of the volumes, select the volume in the drop-down list, then click the **View Details** icon. You can also select a pool, then click **Volumes** in **Roles and Tasks**.
Number of Volumes	The total number of volumes residing in the selected pool.
AD Media Upgrade	Specifies whether the pool media is upgraded to support AD users. NSS64 pools are by default Trustee Index media (includes AD media) upgraded.
Devices	A list of the descriptive device names of all logical devices contributing space in the selected pool.
Number of Devices	The total number of devices currently assigned to the selected pool.
Total Space	The total amount of space assigned to the selected pool.
Free Space	The total amount of space that is currently not in use on the selected pool.
Used Space	The total amount of space that is in use on the selected pool. ◆ **Purgeable Space:** The total amount of space in the selected pool that is currently in use as a salvage area or partitioned space that is not yet otherwise assigned. ◆ **Other In-Use Space:** The total amount of space in the selected pool that is currently in use and cannot be easily deleted without destroying data.
Fstrim Status	Displays whether the fstrim command is running on the selected pool.

Device Detail	Description
Fstrim Last Trimmed Size	The total size trimmed when the fstrim was last executed on the selected pool.
Fstrim Last Executed Time	The timestamp (date and time) that fstrim was last executed on the selected pool.
Block Size	The maximum amount of data committed to a single write. Possible sizes include 4, 8, 16, 32, or 64 KB. The default setting for NSS is 4 KB.
Creation Date	The time stamp (date and time) that the pool was created.
Last Update	The time stamp (date and time) that the pool was last modified by a management action.

Procedure

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Pools** list, select a pool to view its details.

   Wait for the page to refresh and display the pool’s details.
4. The pool must be active to display its details. If the **Details** area is empty, select the pool, then click **Activate**.

   When the page refreshes, you can view the pool’s details.

16.10 Viewing Partition Information for a Pool

Although NSS abstracts the partitions underlying the pool structure, you can view information about those partitions.

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Pools** list, select the pool you want to manage.

   Wait for the page to refresh and display the details. The pool must be active to see partition details.
4. If the pool is deactive, make sure the pool is selected, then click **Activate**.

   After the page refreshes, the **Partitions** drop-down list is available.
5. Click on the arrow next to the **Partitions** drop-down list to expand the list.
6. To view details about a partition, select the partition, then click **View Details**.

   A **Partition Information** page opens where you can view details about the partition.

16.11 Viewing Volume Information for a Pool

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Pools** list, select a pool.

   Wait for the page to refresh and display the details in the **Details** area.
4. To view the volumes in the pool, use one of these methods:
   - In the **Details** area, click the arrow on the **Volumes** drop-down list.

     To view details for a volume in the list, select the volume, then click **View Details**. The **Volumes** page opens with the server and volume preselected.
   - Click **Storage > Volumes**.

     The **Volumes** page opens with the server preselected. To view details for a volume in the **Volumes** list, select the volume, then wait for the page to refresh.

For information about Volume management, see “Managing NSS Volumes” on page 261.

16.12 Viewing Device Information for a Pool

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

   When the page refreshes, a list of pools appears in the **Pools** list.
3. In the **Pools** list, select a pool.

   Wait for the page to refresh and display the pool’s details in the **Details** area.
4. To view the list, in the **Details** area, click the arrow on the **Devices** drop-down list.
5. (Optional) Select the device, then click **View Details** to view its details.

   The **Devices** page opens with the server and device preselected. Wait for the page to refresh to view the device’s details.

For information about device management, see “Managing Devices” on page 125.

16.13 Moving a Pool

You can move an NSS pool from one location to another on the same system. The pool remains active during this process. All the segments in the pool are consolidated and moved to the specified device(s). If a specified device is larger than the original device, the pool is automatically expanded on completion of the move job.

If a clustered pool is moved, on performing cluster resource migration the Move pool job is resumed on other node.

You can use NSSMU or the NLVM command line option to move a pool. You cannot use iManager.

NOTE: When using VmWare EsXi, do not select the entire thin provisioned device for pool move, it might randomly get converted to thick-provisioned device.

1. In NSSMU, select **Pools** from the main menu.
2. Select the pool that you want to move.
3. Press M.
4. Select the device to which you want to move the pool, then press Ins/ENTER.
5. Specify the partition size.

   You can select more than one device at a time. Repeat Step 4 and Step 5 for all the selected devices.
6. (Optional) To remove a selected device from the list, select the device in the lower list and press Delete.
7. (Optional) To change the partition size of a selected device, select the device in the lower list, press Ins/Enter; then modify the size for that device.
8. Press F3 after configuring the devices.

   Pool Information displays the status of move pool as a percentage (%).
9. Press F5 to refresh the status.

   In a cluster setup, the exact status of the pool move can be seen only on the node where the pool move job is in progress.
10. When you select a pool in the Pools list, NSSMU looks at the pool's move status. If the move is not complete (<100%), NSSMU displays the percent complete. If the move is complete (100%), NSSMU finalizes the move by setting the pool to the new location and removing the original location after a confirmation.

    If the move is not complete, you can refresh the pool's display to cause NSSMU to check the move status again. For example, you can use any of these methods to refresh the display:

    - Select another pool, then re-select the pool being moved.
    - While viewing the page for the pool being moved, do a fast refresh by pressing the spacebar or by pressing F5.

For more information on using the NLVM command line option to move the pool, see "Move" in the *OES 2018 SP3: NLVM Reference* guide.

16.14 Preventing Pools from Activating on Multiple Servers

Multiple Server Activation Prevention (MSAP) prevents some accidental activations of a pool on more than one server at a time. You should never purposely attempt to activate a pool on two servers at the same time.

- Section 16.14.1, "Understanding MSAP," on page 226
- Section 16.14.2, "Enabling or Disabling MSAP for All NSS Pools," on page 226
- Section 16.14.3, "Enabling or Disabling MSAP for a Given NSS Pool," on page 227
- Section 16.14.4, "Rebuilding the MSAP Block for a Given NSS Pool," on page 228

- Section 16.14.5, “Determining If MSAP Is Enabled or Disabled on NSS Pools,” on page 229
- Section 16.14.6, “Managing MSAP with XML or APIs,” on page 229
- Section 16.14.7, “Additional Information,” on page 229

16.14.1 Understanding MSAP

MSAP is enabled by default for all pools on the server. When enabled, it helps prevent some accidental activations of a pool on more than one server at a time. It does not catch all multiple activations. MSAP is not meant as a replacement of clustering software that controls shared pools.

MSAP protects pools on systems that do not have clustering installed but are attached to a shared disk by accident. For example, a pool might not be marked with the Shareable for Clustering attribute, but it exists on shared disks seen by multiple servers.

Pool MSAP also protects against dangerous conflicts that can occur if you disable the Shareable for Clustering flag in order to force an activation of a shared pool, or if you use `override=shared` when activating a pool. If MSAP detects a conflict, it deactivates the pool before massive corruption occurs.

If you unload OES Cluster Services NLM software, or if you are not running it, pool MSAP provides an extra level of protection. The clustering software watches pools that are marked with the Shareable for Clustering attribute; MSAP detects conflicting connection from multiple servers and prevents corruption of pools even on devices that are marked as Not Shareable for Clustering.

In some cases, the MSAP software causes pools to take up to 30 seconds to activate. This delay might occur on the next pool activation after the Server ID or the Cluster ID changes for a given server pool. The Server ID changes if the registry is corrupted. The Cluster ID changes if the Cluster eDirectory object ID is lost.

If MSAP is enabled, all active NSS pools are read every 14 seconds. If your storage media are not shared between multiple servers such as in a SAN, you can clear the zpool_feature_msap bit. You should not clear this bit if your pools are on physically shared storage media.

If a pool can be accessed by older servers not running the Support Pack with the MSAP software, then multiple pool activations can still occur.

IMPORTANT: MSAP does not protect against partition conflicts for pools. It does not prevent multiple servers from creating a pool in the same partition.

16.14.2 Enabling or Disabling MSAP for All NSS Pools

By default, MSAP is enabled for all pools on the server when the server is booted.

To manually enable or disable MSAP for all pools on the server, issue the following MSAP console commands at the NSS Console (`nsscon`) as the `root` user.

nss /msapserver

Enables MSAP for all the pools on the server. By default, MSAP is enabled for every pool on the server.

nss /nomsapserver

Disables MSAP for all the pools on the server. This command remains in effect only until the server is next rebooted.

IMPORTANT: We recommend that you never disable MSAP.

16.14.3 Enabling or Disabling MSAP for a Given NSS Pool

Use the procedures in this section to enable or disable MSAP for a given pool.

The `/PoolMSAP` option enables MSAP for a given pool on the server. Use the command when the pool is activated. MSAP is enabled the next time the pool is activated.

The `/NoPoolMSAP` option disables MSAP for a given pool. Use the command when the pool is activated. MSAP is disabled the next time the pool is activated.

IMPORTANT: We recommend that you never disable MSAP.

1. Open a terminal console, then log in as the `root` user.
2. If the pool is not active, activate it now.
   - **2a** Start NSSMU by entering the following at the terminal console prompt:

     ```
     nssmu
     ```

   - **2b** Go to the **Pools** page.
   - **2c** Select the pool, then activate it by pressing **F7**.
   - **2d** Exit NSSMU.
3. Enable or disable MSAP for a given pool.
   - **3a** Start the NSS Console by entering the following at the terminal console prompt:

     ```
     nsscon
     ```

   - **3b** At the `nsscon` prompt, do one of the following:
     - **Enable MSAP:** Enter

       ```
       nss /poolmsap=poolname
       ```

     - **Disable MSAP:** Enter

       ```
       nss /nopoolmsap=poolname
       ```

   - **3c** Close the NSS Console by entering

     ```
     exit
     ```

4. Deactivate the pool, then activate it again.
   - **4a** Start NSSMU by entering the following at the terminal console prompt:

     ```
     nssmu
     ```

   - **4b** Go to the **Pools** page.

4c Select the pool, then deactivate it by pressing **F7**.

4d Select the pool, then activate it by pressing **F7** again.

4e Exit NSSMU.

MSAP is now enabled or disabled, depending on your action in Step 3.

5 Verify that MSAP is enabled or disabled for the given pool.

5a Start the NSS Console by entering the following at the terminal console prompt:

```
nsscon
```

5b At the `nsscon` prompt, enter

```
nss /pools
```

5c Review the messages to determine if the pool was successfully enabled or disabled as follows:

- **MSAP Enabled:** The **Multi-Use Detect** message is displayed for the pool.
- **MSAP Disabled:** The **Multi-Use Detect** message is not displayed for the pool.

5d Close the NSS Console by entering

```
exit
```

16.14.4 Rebuilding the MSAP Block for a Given NSS Pool

If the MSAP block for a pool becomes corrupt, it prevents a pool from going into the Maintenance state. Use the `/MSAPRebuild` option to rebuild a pool's corrupt MSAP block. Before issuing the command to rebuild, you must deactivate the pool. Rebuilding an MSAP block does not give the rebuilder ownership of the pool.

1 Open a terminal console, then log in as the `root` user.

2 Deactivate the pool.

2a Start NSSMU by entering the following at the terminal console prompt:

```
nssmu
```

2b Go to the **Pools** page.

2c Select the pool, then deactivate it by pressing **F7**.

2d Exit NSSMU.

3 Rebuild the MSAP block for the pool.

3a Start the NSS Console by entering the following at the terminal console prompt:

```
nsscon
```

3b At the `nsscon` prompt, enter

```
nss /msaprebuild=poolname
```

3c Close the NSS Console by entering

```
exit
```

4 Activate the pool.

4a Start NSSMU by entering the following at the terminal console prompt:

```
nssmu
```

4b Go to the **Pools** page.

4c Select the pool, then activate it by pressing **F7**.

4d Exit NSSMU.

The pool should now be able to be placed in Maintenance mode.

16.14.5 Determining If MSAP Is Enabled or Disabled on NSS Pools

The `nss /pools` command displays the message **Multi-Use Detect** for NSS pools that have MSAP enabled.

1 At the NSS Console (nsscon) prompt, enter

```
nss /pools
```

2 For each pool, review the messages to determine whether MSAP is enabled or disabled as follows:

- **MSAP Enabled:** The **Multi-Use Detect** message is displayed for the pool.
- **MSAP Disabled:** The **Multi-Use Detect** message is not displayed for the pool.

16.14.6 Managing MSAP with XML or APIs

The `_admin\manage_nss\pool\`*`poolname`*`\zlss\msap.xml` file contains MSAP statistics for the pool. One file exists for each pool.

The MSAP attribute is displayed in the Enabled Attributes (<enabledAttributes>) tag of the `poolinfo.xml` management file.

For `manage.cmd`, the pool operation `getPoolInfo` returns the MSAP tag (<msap>) in the Supported Attributes tag (<supportedAttributes>) and the Enabled Attributes tag (<enabledAttributes>).

For APIs, the pool feature zpool_feature_msap can be viewed and controlled using the `zGetInfo` and `zModifyInfo` commands.

16.14.7 Additional Information

For more information about the MSAP commands used in this section, see Section A.21, “Multiple Server Activation Prevention (MSAP) Commands,” on page 463.

16.15 Updating eDirectory Pool Objects

On the **Pools** page the Update eDirectory option, adds or updates the NetIQ eDirectory pool object at the same context level as the server. NSS searches for the object. If the pool object exists, NSS prompts you with two options: Delete and replace the existing object, or Retain the existing object. If the pool object does not exist, NSS adds the object to the same context level where the server exists.

NOTE: Updating eDirectory pool object is a recovery process it is required only when the pool object is lost, corrupted, or deleted.

To update eDirectory from iManager, perform the following steps:

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Pools** list, select the pool you want to update.

   Wait for the page to refresh. It displays the pools’s details and enables its management options.
4. Click **Update eDirectory**.

To update eDirectory from NSSMU, perform the following steps:

1. Go to NSSMU.
2. Select the pool you want to update.
3. Press *F4* to perform NDS update.

   NOTE: When doing an NDS Update on a non-replica server, the operation might fail because of the eDirectory synchronization issue on non-replica servers.

   Retry the eDirectory object update after the completion of eDirectory synchronization, and the object update operation will succeed.

16.16 Updating eDirectory for Shared Pool

To update eDirectory for Shared Pool from iManager, perform the following steps:

1. Make the cluster resource offline.
   - **1a** In iManager, click **Clusters > My Clusters**, select the name link of the cluster to open the Cluster Manager page. If the cluster does not appear in the **My Clusters** list, you can add it. Click **Add**, browse for the cluster, then click **OK**.
   - **1b** Select the check box next to the resource that you want to take offline, then click **Offline**.
2. Delete the cluster resource.
   - **2a** In iManager, click **Clusters > My Clusters**, select the name link of the cluster, then click the Cluster Options tab.
   - **2b** Select the check box next to the resource that you took offline in Step 1, click **Delete**.

IMPORTANT: When you delete (or delete and replace) a Pool object in eDirectory, the attributes for that pool is removed in the User objects for any users that reference that pool. When that pool object is deleted, eDirectory needs to clean up all references to the object being deleted.

3 Activate the Pool.

   3a In iManager, click **Storage > Pools**.

   3b Select the server where the pool exists.

   3c Select the pool from the pools list that you want to activate.

   3d Click *Activate*.

4 Update the eDirectory.

   4a Select the pool and click on *Update eDirectory*.

   IMPORTANT: Updating a pool's eDirectory object might delete the pool's existing volumes' eDirectory objects.

   4b (Conditional) If the pool's existing volumes' eDirectory objects are not available, update the eDirectory objects for existing volumes.

5 Cluster enable the pool. For more information, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

6 Bring the cluster resource online.

   6a In iManager, click **Clusters > My Clusters**, select the name link of the cluster to open the Cluster Manager page.

   6b Select the check box next to the cluster resource that you want to bring online, then click **Online**.

To update eDirectory for Shared Pool from command prompt, perform the following steps:

1 Make the cluster resource offline.

   Run the command, `cluster offline` <*resource name*>.

2 Delete the cluster resource from iManager. For more information, see Step 2 on page 230.

3 Activate the Pool.

   3a Go to NSSMU.

   3b Select the pool you want to activate.

   3c Press *F7*.

4 Update the eDirectory.

   4a Press *F4* to NDS Update the pool.

   IMPORTANT: Updating a pool's eDirectory object might delete the pool's existing volumes' eDirectory objects.

   4b (Conditional) If the pool's existing volumes' eDirectory objects are not available, update the eDirectory objects for existing volumes.

5 Cluster enable the Pool. For more information, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

6 Bring the cluster resource online.

Run the command, `cluster online` *<resource name>*.

16.17 What's Next

You can now create volumes in the NSS pools you created. For information, see Chapter 19, "Managing NSS Volumes," on page 261.

17 Verifying and Rebuilding NSS Pools and Volumes

This section describes how to verify and rebuild OES Storage Services pools to restore the consistency of a pool's metadata structure, and thus, the metadata structure of its volumes.

- Section 17.1, "When to Use Verify and Rebuild," on page 233
- Section 17.2, "Verifying and Rebuilding an NSS Pool and Its Volumes," on page 235
- Section 17.3, "ReZIDing Volumes in an NSS Pool," on page 239

17.1 When to Use Verify and Rebuild

NSS allows you to temporarily deactivate individual storage pools to fix volume problems instead of bringing down the server. However, when you deactivate a storage pool, users do not have access to any of the volumes in that pool. All of the volumes on the pool are part of the verify or rebuild process.

WARNING: After rebuilding an NSS pool, previously deleted volumes can not be salvaged.

The purpose of the Pool Verify and Pool Rebuild utilities is to make sure you have a valid metadata structure for a pool. Use the utilities only when you have problems with the pool's metadata structure.

- Section 17.1.1, "What Verifying Does Not Do," on page 233
- Section 17.1.2, "What Rebuilding Does Not Do," on page 233
- Section 17.1.3, "Before Verifying a Pool," on page 234
- Section 17.1.4, "Before Rebuilding a Pool," on page 234

17.1.1 What Verifying Does Not Do

Verifying a pool does not fix any problems. It is a read-only assessment of the pool's metadata structure to identify the types of errors, the severity of errors, and in what volumes the errors occur.

17.1.2 What Rebuilding Does Not Do

Rebuilding a pool restores the consistency of the pool's metadata structure. Rebuilding a pool does not restore lost data and does not repair the data integrity of corrupted data.

Rebuilding a pool does not fix problems for the following:

- Journaling errors
- Hardware and media errors

- File system trustee assignments, trustee rights, and inherited rights filters
- File system attributes for files and directories
- Opportunistic locking
- Content of files

17.1.3 Before Verifying a Pool

Volume errors are typically transactions left unfinished during a system crash of some kind. Most volume errors are fixed automatically during volume mount when NSS resolves the journaled errors. If the pool can be mounted, mount its volume to allow the NSS journaling feature to repair any transactional errors that occurred during a system failure.

Afterwards, if there are still problems use diagnostic tools to rule out hardware problems as the cause.

If non-hardware errors persist, and if you have a viable backup to restore the pool to the last known good state, restore the backup to recover the pool and restore the data. It is probably not necessary to verify or rebuild the pool.

If non-hardware errors persist, and if you do not have a viable backup, use the following Pool Verify utilities to identify any errors in the pool's metadata:

- `ravsui` (verify option)
- `ravview` (reformats log files to human-readable format)

17.1.4 Before Rebuilding a Pool

Review the verification log to determine the type and severity of problems with the pool's metadata.

If all of the following conditions exist, then you should rebuild the pool to restore its metadata integrity.

- Errors were not corrected by mounting the volume, or you could not mount the volume.
- Errors were not caused by media or hardware problems, or they persisted after correcting any media or hardware issues.
- You have no viable backup of the pool's volumes to restore the pool to the last known good state.
- The Pool Verify process reports errors in the physical integrity of any of the volumes' metadata that would definitely cause data corruption if no action is taken.
- More data will be lost from continued data corruption than will be lost from rebuilding the pools now.

WARNING: You should rebuild a pool only as a last resort to restore the consistency of the pool's metadata. The rebuild repairs the metadata; it does not recover lost data or repair the integrity of the data itself. Data loss occurs during a rebuild if the utility must prune leaves in the data structure to restore metadata consistency.

If the Pool Verify process did not report errors, but you cannot create files or directories, you should run rebuild with the ReZID option. For information, see Section 17.3, “ReZIDing Volumes in an NSS Pool,” on page 239.

If you are not sure whether you can tolerate a system rebuild, take a pool snapshot and run the rebuild against the pool snapshot instead. Then if the rebuild is acceptable, you can replace the pool with the rebuilt snapshot. For information about pool snapshots, see Chapter 18, “Managing NSS Pool Snapshots,” on page 243.

If necessary, rebuild the pool's metadata by using the following utilities:

- `ravsui` (build option)
- `ravview` (reformats log files to human-readable format)

17.2 Verifying and Rebuilding an NSS Pool and Its Volumes

- Section 17.2.1, “Mounting the Volume to Repair Journaled Errors,” on page 235
- Section 17.2.2, “Ruling Out Hardware Causes,” on page 235
- Section 17.2.3, “Verifying the Pool to Identify Metadata Inconsistencies,” on page 236
- Section 17.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 236
- Section 17.2.5, “Rebuilding NSS Pools to Repair Metadata Consistency,” on page 237

17.2.1 Mounting the Volume to Repair Journaled Errors

Volume errors are typically transactions left unfinished during a system crash of some kind. This type of error is fixed automatically during volume mount by the NSS journaling feature.

If errors persist after you mount the volume, or if you cannot mount the volume, first rule out hardware causes for the problems. For information, see Section 17.2.2, “Ruling Out Hardware Causes,” on page 235.

17.2.2 Ruling Out Hardware Causes

If a volume cannot be mounted or problems persist after journaling errors are resolved, check the hardware for faulty media or controller problems.

1. Make sure you have a good backup of the data.
2. Use the latest diagnostic software and utilities from the manufacturer of your hard drives and controllers to troubleshoot the hard drives without destroying the data.

   For example, verify the media integrity and that devices are operating correctly.
3. If necessary, repair the media or controllers.

If errors persist after you have ruled out hardware causes, and you do not have a viable backup to restore to the last known good state, you should check the pool for metadata inconsistencies. For information, see Section 17.2.3, “Verifying the Pool to Identify Metadata Inconsistencies,” on page 236.

17.2.3 Verifying the Pool to Identify Metadata Inconsistencies

The verify process is a read-only assessment of the pool. The Pool Verify option searches the pool for inconsistent data blocks or other errors in the file system's metadata and reports data in the verification log. For information on where to find the verification log and how to interpret any reported errors, see Section 17.2.4, "Reviewing Log Files for Metadata Consistency Errors," on page 236.

1 Place the pool in maintenance mode.

   1a At a terminal prompt, enter

   ```
   nss /PoolMaintenance=poolname
   ```

2 Start the pool verify by entering the following at the terminal console prompt:

   ```
   ravsui verify poolname
   ```

3 Use RAVVIEW to read the logs.

   For information about using RAVVIEW, see Section B.8, "ravview," on page 499.

4 Do one of the following:

   - If the log reports no errors with the pool's metadata, it is safe to activate the pool and mount the volumes.
   - If the log reports no errors with the pool's metadata, but you still cannot create files or directories, run a Pool Rebuild with the ReZID option. For information, see Section 17.3, "ReZIDing Volumes in an NSS Pool," on page 239.
   - If the log reports errors with the pool's metadata, the affected volumes remain in Maintenance mode. Decide whether to rebuild the pool based on the type of error and potential outcomes. For information about rebuilding the pool, see Section 17.2.5, "Rebuilding NSS Pools to Repair Metadata Consistency," on page 237.

17.2.4 Reviewing Log Files for Metadata Consistency Errors

Make sure to check the error log whenever an NSS volume does not come up in active mode after a verify or rebuild.

- "Log Files and On-Screen Display" on page 236
- "Warnings Reported" on page 237
- "Errors Reported" on page 237
- "No Errors Reported, but Cannot Create Files or Directories" on page 237

Log Files and On-Screen Display

Messages are written to the following logs:

Table 17-1 *Location of Log Files for the NSS Pool Verify and Pool Rebuild Utilities*

Log	Purpose
`/var/opt/novell/log/nss/rav/`*`filename`*`.vbf` This is the default location, but you can specify the location and the filename.	Log of the pool verify process using `ravsui verify`. If a volume has errors, the errors are displayed on the screen and written to this log file of errors and transactions. Use the `ravview` utility to read logs. For information, see Section B.8, “ravview,” on page 499.
`/var/opt/novell/log/nss/rav/`*`filename`*`.rtf`	Log of the pool rebuild process using `ravsui rebuild`. This log contains information about data that has been lost during a rebuild by the pruning of leaves in the data structure.

Whenever you verify or rebuild a pool, the new information is appended at the end of the log file. If you want to keep old log files intact, rename the log file or move it to another location before you start the verify or rebuild process.

Warnings Reported

Warnings indicate that there are problems with the metadata, but that there is no threat of data corruption. Performing a data restore from a backup tape or rebuilding the pool’s metadata are optional. However, rebuilding a pools’s metadata typically results in some data loss.

Errors Reported

Errors indicate that there are physical integrity problems with the pool’s metadata, and data corruption will definitely occur, or it will continue to occur, if you continue to use the pool as it is.

If you decide to rebuild the pool, use the Pool Rebuild utility. For information, see Section 17.2.5, “Rebuilding NSS Pools to Repair Metadata Consistency,” on page 237.

No Errors Reported, but Cannot Create Files or Directories

If the verify log does not report errors, but you continue to be unable to create files or directories on volumes in the pool, it might be because the files’ ID numbers have exceeded the maximum size of file numbering field. You might need to rebuild the pool with the ReZID option. For information about how to decide if a ReZID is needed, see Section 17.3, “ReZIDing Volumes in an NSS Pool,” on page 239.

17.2.5 Rebuilding NSS Pools to Repair Metadata Consistency

The purpose of a pool rebuild is to repair the metadata consistency of the file system. Rebuild uses the existing leaves of an object tree to rebuild all the other trees in the system to restore visibility of files and directories. It checks all blocks in the system. Afterwards, the NSS volume remains in maintenance mode if there are still errors in the data structure; otherwise, it reverts to the active state.

WARNING: Data will be lost during the rebuild.

A pool rebuild depends on many variables, so it is difficult to estimate how long it might take. The number of storage objects in a pool, such as volumes, directories, and files, is the primary consideration in determining the rebuild time, not the size of the pool. This is because a pool rebuild is reconstructing the metadata for the pool, not its data. For example, it would take longer to rebuild the metadata for a 200 GB pool with many files than for a 1 TB pool with only a few files. Other key variables are the number of processors, the speed of the processors, and the size of the memory available in the server.

You do not need to bring down the server to rebuild a pool. NSS allows you to temporarily place an individual storage pool in maintenance mode while you verify or rebuild it. While the pool is deactivated, users do not have access to any of the volumes in that pool.

If you do not place the pool in maintenance mode before issuing the rebuild or verify commands, you receive NSS Error 21726:

```
NSS error: PoolVerify results

   Status: 21726

     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED

   Source: nXML.cpp[1289]
```

To rebuild the pool:

1. Depending on the nature of the reported errors, you might want to open a call with Micro Focus Support before you begin the rebuild process.
2. Place the pool in maintenance mode.

   2a At a terminal prompt, enter

   ```
   nss /PoolMaintenance=poolname
   ```

3. Start the pool rebuild. At the terminal console prompt, enter

   ```
   ravsui rebuild poolname
   ```

   For information, see Section B.7, “ravsui,” on page 496 for options to set the pruning parameters for the rebuild.

   Rebuilding can take several minutes to several hours, depending on the number of storage objects in the pool.

4. Review the log on-screen or in the *filename*`.rtf` file to learn what data has been lost during the rebuild.

   For information, see Section 17.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 236.

5. Do one of the following:

   - **No Errors:** If errors do not exist at the end of the rebuild, the pool’s volumes are available for mounting.
   - **Errors:** If errors still exist, the pool remains in the maintenance state. Repeat the pool verify to determine the nature of the errors, then call Micro Focus Support for assistance.

17.3 ReZIDing Volumes in an NSS Pool

- Section 17.3.1, “What Is a ZID?,” on page 239
- Section 17.3.2, “Understanding ReZID,” on page 239
- Section 17.3.3, “When to ReZID,” on page 239
- Section 17.3.4, “Viewing the Highest ZID for a Volume,” on page 240
- Section 17.3.5, “ReZIDing Volumes,” on page 241

17.3.1 What Is a ZID?

When a file is created, it is assigned a unique file number, called a ZID. In NSS, the maximum number of file ZIDs available is a 64-bit number, which provides for up to 8 trillion (8E12) ZIDs, so NSS was designed to not re-use ZIDs.

The ZID of a file is an internal file system bit of information. Under Linux, inode number and ZIDs are the same. You can view a file's ZID using the command `ls --inode`. However, the highest ZID number in use for each volume is reported when you verify a pool.

17.3.2 Understanding ReZID

The ReZID option for a pool rebuild changes the ZIDs for all the files on the volume, thus freeing ZIDs so they are available for creating new files and directories. The rezid does not modify any other metadata on the volumes, nor does it modify any file’s content. The reZID is unrelated to any other rebuild activities that might occur.

IMPORTANT: The reZID step in a rebuild adds a third review of the pool and can increase the time of a rebuild by 50%.

17.3.3 When to ReZID

After verifying a pool, the log reports the highest ZID (highestZID parameter) for each volume in the pool. For NSS volumes, if the `nextAllocatableZid` is greater than `0xeffffffe` (default value), the reZID occurs automatically when you rebuild a pool. You can optionally specify a different ZID limit to trigger the rezid. However, if the `nextAllocatableZid` is greater than `0xffffffff`, the rezid operation is skipped for that volume but still you are allowed to create new files and folders.

Beginning with OES 2018,

- For local volumes, the 64-bit ZID support is enabled by default in both the homogeneous and mixed-node cluster environment.
- For shared volumes, the 64-bit ZID support is enabled by default only in homogeneous cluster environment.

NOTE: In a mixed-node cluster environment, the 64-bit ZID support is not enabled for shared volumes. You can still force enable the 64-bit ZID support on shared volumes using the `/ForceEnableZID64` command.

- When a resource with a shared volume whose `nextAllocatableZid` is greater than `0xffffffff` is migrated to a node that is not 64-bit ZID enabled for shared volumes, then the 64-bit ZID support is automatically enabled for shared volumes in that node.

To check if the shared volume is already enabled for 64-bit ZID, use `/DisplayZID64Status` command. If 64-bit ZID is not enabled for a shared volume, the following needs to be taken care:

There are no errors reported if ZIDs are nearing the upper limit of 4 billion for a volume. You might get errors creating a file or directory that suggest a reZID needs to be done. For example:

- NDS database is locked.
- Server hangs at the end of load stage 1.
- Cannot copy to a volume.

NSS API calls return `Error 20108 zERR_ZID_GREATER_THAN_32_BITS`, which means that the ZID numbering has reached the 4 billion (4E9) limit. NSS also sends a volume alert to the server console that reZID needs to be done on a specified volume. The calling application gets only a generic error when it attempts and fails to create the file.

After rebuilding a pool with the ReZID option, the errors you were getting when creating files and directories no longer occur. You can also verify the pool again, then check the highest ZID number reported for the pool's volumes to know that each is well under the 4 billion ZIDs limit.

If you do not place the pool in maintenance mode before rebuilding the pool with the ReZID option, you receive NSS Error 21726:

```
NSS error: PoolVerify results

   Status: 21726

     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED

   Source: nXML.cpp[1289]
```

17.3.4 Viewing the Highest ZID for a Volume

To view the highest ZID per volume:

- Go to the file, `/_admin/Manage_NSS/Volume/<volumename>/VolumeInfo.xml` and search for `nextAllocatableZid`.

  OR

- On verifying a pool, look in the log to find the highest ZID value that has been assigned for each of the pool's volume. Look at each value to see whether you should rezid the pool as part of the rebuild process.

You should be aware of the rate at which you are consuming ZIDs by creating and deleting files. If the `nextAllocatableZid` for a given volume reaches `0xffffffffffffffff`, you cannot create new files on the volume.

17.3.5 ReZIDing Volumes

1 Place the pool in maintenance mode.

1a At a terminal prompt, enter

```
nss /PoolMaintenance=poolname
```

2 If you have not already verified the volume, enter the following at a command prompt:

```
ravsui verify poolname
```

For information, see Section B.7, “ravsui,” on page 496.

3 Review any errors on-screen or in the *filename*.vbf file, located where you specified.

For information, see Section 17.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 236.

4 Rebuild a pool by entering the following at a command prompt

```
ravsui --rezid=zid rebuild poolname
```

Replace *zid* with the value of a threshold to cause a reZID of a volume. The default value is 0xefffffff. For information, see Section B.7, “ravsui,” on page 496 for options to set the pruning parameters for the rebuild.

For NSS, a rebuild automatically causes a reZID of a volume if the rebuild finds a ZID over the default value. However, if the nextAllocatableZid is greater than 0xffffffff, the rezid operation is skipped for that volume.

This checks all blocks in the system. Rebuilding can take several minutes to several hours, depending on the number of objects in the pool. For all systems, reZID adds a third pass to the rebuild, which increases the time to rebuild a volume by about 50%.

5 Review the log on-screen or in the *filename*.rtf file to learn what data has been lost during the rebuild.

For information, see Section 17.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 236.

6 Do one of the following:

- **Errors:** If errors still exist, the pool remains in the maintenance state. Repeat the pool verify to determine the nature of the errors, then contact Micro Focus Support for assistance.
- **No Errors:** If errors do not exist, the pool’s volumes are mounted automatically.

18 Managing NSS Pool Snapshots

OES Storage Services supports pool snapshots to improve backup and restore services. This section describes the following:

- Section 18.1, “Understanding Pool Snapshots,” on page 243
- Section 18.2, “Guidelines for Using and Managing Pool Snapshots,” on page 245
- Section 18.3, “Creating a New Pool Snapshot,” on page 250
- Section 18.4, “Viewing a List of Snapshots for a Given Pool,” on page 253
- Section 18.5, “Viewing Pool Snapshot Details,” on page 254
- Section 18.6, “Modifying the Stored-On Location for Snapshots,” on page 255
- Section 18.7, “Onlining or Offlining a Pool Snapshot,” on page 255
- Section 18.8, “Viewing and Managing an Online Pool Snapshot,” on page 257
- Section 18.9, “Restoring Data from an Online Pool Snapshot,” on page 258
- Section 18.10, “Deleting a Pool Snapshot,” on page 259

18.1 Understanding Pool Snapshots

- Section 18.1.1, “How Snapshots Work,” on page 243
- Section 18.1.2, “Benefits of Using Snapshots,” on page 244

18.1.1 How Snapshots Work

A pool snapshot is a metadata copy of a storage data pool that preserves a point-in-time view of a data pool. The pool snapshot function uses copy-on-write technology to enable the instantaneous block-level snapshot of a pool, while requiring only a fraction of the storage space of the original data pool. A pool snapshot does not save an exact copy of the original data pool. Instead, the snapshot is a metadata-based copy that stores only the blocks of data that change subsequent to the instant of the snapshot. The snapshot combines the metadata and stored block data with the unchanged data on the original pool to provide a virtual image of an exact copy of the data at the instant the snapshot was taken, plus any end-user modifications made to that snapshot.

Before the snapshot can occur, the snapshot function must quiesce the original pool by briefly halting all data transaction activity when current transactions complete. It temporarily prevents new writes to the pool and flushes the file system cache to make the pool current with existing writes. Any open files are seen by the snapshot feature as being closed after these outstanding writes occur. Then, it snapshots the now-stable pool, and allows data transaction activity to resume.

The quiescence process provides a transactionally consistent image at the instant the snapshot is made. Because the snapshot is consistent, it is not necessary to check the consistency of the file system or database if you activate the snapshot for access.

When the pool is active, each of its snapshots is active. For each write, the snapshot function determines which blocks in the original pool will change. It temporarily suspends the write activity while it copies the original block data to each snapshot's *stored-on partition*, then it writes the changed data to the blocks on the original pool. This copy-on-write process keeps the snapshot metadata consistent in time with the exact instant the snapshot was taken.

The snapshot grows as more blocks are changed on the original pool. Theoretically, if all of the original blocks changed, each snapshot's stored-on partition would need to be as big as the original pool. Typically, the disk space needed for each pool snapshot is 10 percent to 20 percent of the original pool size. The amount of space required depends on the snapshot retention policy and the turnover rate for data in the original pool. A snapshot should never be allowed to completely fill its stored-on partition.

The number of snapshots is limited only by the kernel memory required to create the snapshot and buffers. Each additional snapshot incrementally consumes more kernel memory and degrades I/O performance. On Linux, each snapshot functions independently of the others. The copy-on-write process must copy the block content to every snapshot before it can write the modified block data to the pool.

18.1.2 Benefits of Using Snapshots

Pool snapshots save time and preserve data. They provide an instant copy of a pool that can help expedite routine maintenance procedures to back up, archive, and protect data on that pool. Because traditional methods of duplicating large amounts of data can be expensive and time-consuming, the efficiency of snapshots can be an important benefit for your enterprise. You can make snapshots as frequently as needed to meet your data availability and resilience requirements.

You can use pool snapshots in a variety of ways to enhance your current storage infrastructure, including the following scenarios.

- “Supporting Backup Operations” on page 244
- “Archiving Data” on page 245
- “Restoring Data” on page 245
- “Re-Creating Operational and Development Environments” on page 245
- “Testing and Training” on page 245

Supporting Backup Operations

A pool snapshot facilitates non-disruptive backups because the snapshot becomes the source of the backup. When you back up volumes in a pool from a pool snapshot, your backup can capture every file in the pool, even those that are in use at the time. You can create, manage, and delete a pool snapshot for any pool on your server.

As contrasted to a traditional, full-data copy of the pool, the metadata copy only takes a moment to create and occurs transparently to the user. With traditional backups, applications might be shut down throughout the backup routine. In comparison, the pool snapshot process makes the original pool available with almost imperceptible delay.

Archiving Data

You can archive pool snapshots to maintain a point-in-time history of the changes made to the original data pool.

Restoring Data

Pool snapshots can serve as a source for recovering a point-in-time version of a file. After you take a snapshot, you can activate it at a later time to access the original pool's data as it existed at the time of the snapshot. Both the pool and its snapshots can be active and available concurrently. You access data on the active pool snapshot just as you would do on any other pool, even while data is changing on the original pool you snapped. To restore data, manually copy the old version of the file from the online snapshot volume to the original volume. For information, see Section 18.7, "Onlining or Offlining a Pool Snapshot," on page 255.

Two common reasons to restore information are user error and application errors.

- A user might inadvertently make changes to a file that need to be reversed. Files can become corrupted or deleted. The pool snapshot provides a quick and easy way to locate and reinstate selected files.
- An application might be infected by a virus or be corrupted by other problems, causing the application to store erroneous data throughout the pool. With a pool snapshot, you can easily restore all or part of the original pool to a point in time before the virus or problem was known to exist in the system.

Re-Creating Operational and Development Environments

You can also write to the pool snapshot, just as you would any pool. You can work with and modify the snapshot version of the data. For example, in a software development environment, engineers might want to repeat builds and tests of data within a given snapshot.

Testing and Training

Snapshots can provide a convenient source for testing and training environments and for data mining purposes.

18.2 Guidelines for Using and Managing Pool Snapshots

Use the guidelines in this section when planning your snapshot solution:

- Section 18.2.1, "Differences Between Snapshots on Linux and NetWare," on page 246
- Section 18.2.2, "Guidelines for Creating a Pool Snapshot," on page 247
- Section 18.2.3, "Guidelines for Creating Pool Snapshots of Clustered Pools," on page 247
- Section 18.2.4, "Guidelines for Naming Pool Snapshots," on page 247
- Section 18.2.5, "Guidelines for Choosing the Stored-On Location," on page 248
- Section 18.2.6, "Guidelines for Maintaining the Stored-On Location," on page 249

- Section 18.2.7, “Guidelines for Onlining Pool Snapshots,” on page 249
- Section 18.2.8, “Guidelines for Deleting Pool Snapshots,” on page 250

18.2.1 Differences Between Snapshots on Linux and NetWare

For NSS on Linux, snapshot volumes are not automatically mounted on reboot as they are in NetWare. The snapshots are active and performing their snapshot functions, but they are not mounted. If a snapshot was mounted when the server went down and you want the snapshot mounted after reboot, you must mount it manually. Mounting a snapshot is necessary only if users require access to the point-in-time version of the data.

In NSSMU, devices that contain NSS pool snapshots cannot be re-initialized. To initialize the device, you must first delete all NSS pool snapshots on the device. For information about deleting snapshots, see Section 18.10, “Deleting a Pool Snapshot,” on page 259.

Table 18-1 identifies the differences for using snapshots for NSS pools on Linux and NetWare:

Table 18-1 *Comparison of NSS Pool Snapshots on Linux and NetWare*

Capability	NetWare	Linux
Rename a snapshot	Supported	Not supported. If you attempt to rename a snapshot, you get an eDirectory error because eDirectory objects are not automatically created for pool snapshots.
Snapshot stored-on location	An NSS pool is designated as the stored-on partition for a given original pool.	An NLVM-managed Linux partition is designated as the stored-on partition for a given original pool.
Snapshots of cluster-enabled pools	Supported The stored-on partition must be the same as the original pool.	Not supported
eDirectory object for the snapshot	eDirectory objects are automatically created for the snapshot pools and volumes.	No eDirectory objects are created. In order to allow users to access data on an NSS pool snapshot, you must first activate and mount the snapshot as an NSS pool, then use the **Update eDirectory** option on the **Storage > Pools** page to create an eDirectory object for the snapshot pool or volume.
Taking new snapshots	The stored-on partition must be activated and mounted.	The stored-on Linux partition must be mounted.

Capability	NetWare	Linux
Deleting snapshots	Delete pool snapshots in a first-created, first-deleted order.	Snapshots can be deleted in any sequence.
Shredding deleted snapshots	Supported	Not supported

18.2.2 Guidelines for Creating a Pool Snapshot

Create a pool snapshot when you want to capture a point-in-time view of a active data pool. The original pool must be active when you create the snapshot. For instructions on creating a pool snapshot, see "Creating a New Pool Snapshot" on page 250.

18.2.3 Guidelines for Creating Pool Snapshots of Clustered Pools

Pool snapshots are not supported for clustered NSS pools on Linux.

18.2.4 Guidelines for Naming Pool Snapshots

You name a pool snapshot at the time you order the snapshot. Specify a unique name for each snapshot. Because the name also serves as the snapshot's poolname when active, the name you give it should be unique among snapshots and among pools. The combination of the snapshot's name and time stamp when the snapshot was taken can help you identify the snapshot version you want to manage.

- "Default Naming Scheme When Using iManager" on page 247
- "Alternate Naming Scheme" on page 248
- "Considerations for Naming" on page 248

Default Naming Scheme When Using iManager

When you create a snapshot in iManager, the snapshot name is by default a modified version of the original pool's name, which allows a simple identification of all snapshots for any given pool. NSS adds a letter and number designator (_*Sn*) to the original pool name. The *S* indicates that it is a snapshot. The *n* represents an incremental number (1 to 500) of snapshots taken for this pool.

IMPORTANT: When you create a snapshot in NSSMU, no default name is suggested. You can optionally adopt the default naming scheme when you provide a name for the pool snapshot.

For example, pool snapshot names for POOLA might be POOLA_S1, POOLA_S2, and so on.

If you delete snapshots out of sequence, it is possible that the numbers could be reused. A simple sort by snapshot name could be confusing. Make sure to verify the create stamp on the pool when you work with pool snapshots that use the default naming scheme.

The snapshot name can be 2 to 16 characters in length and must adhere to the same character conventions as for poolnames. If the poolname is too long to allow the snapshot identifier to be appended, the poolname is truncated so that the length of the pool snapshot name is 16 characters. For example, if the poolname is POOL_EUR_MANUF (14 characters), its name would be truncated

then the snapshot identifier appended. The number of characters to be truncated would depend upon the pool snapshot number, such as POOL_EUR_MANU_S1, POOL_EUR_MAN_S12, or POOL_EUR_MA_S102

If you bring a pool snapshot online, its volume names are automatically renamed to indicate that they are snapshot volumes. By default, *_SV* is added to volume names to indicate the storage object is a volume in a pool snapshot.

For example, if your original pool is named `users`, its default pool snapshot name is `users_s1`. If its volumes are named `users_aj` and `users_ kz`, the volumes in the snapshot pool are `users_aj_sv`, `users_aj_sv001` and `users_kz_sv`, `users_kz_sv001` and so on.

Alternate Naming Scheme

You can optionally adopt your own naming convention for pools. If you create multiple snapshots of a pool each day, consider using a logical naming convention that identifies the poolname and numbers that allow sequential listing based on the order the snaps were taken. Of course, the time stamp shows the exact time that the snapshot was taken, and you can always refer to it to be sure you have the right snapshot.

Considerations for Naming

It is also important to consider the names of existing pools and pool snapshots and your naming conventions when you name new data pools and volumes. You should get errors if you attempt to create pools with names that are in use by pool snapshots, and vice versa.

If a volume with the same name as a snapshot volume exists on the server when you mount a snapshot pool, NSS automatically appends the snapshot volume name with an additional sequential number (such as `VOL1_SV001`) or characters (such as `VOL1_SV_SV`) as it onlines the volume. This makes the snapshot name unique with respect to the active volumes while the pool snapshot is online.

If name conflicts occur, you might need to rename a pool or pool snapshot to a unique name in order to bring the pool snapshot online.

18.2.5 Guidelines for Choosing the Stored-On Location

Each snapshot that you create for a pool needs its own stored-on partition. Specify an NLVM-managed device where you want to create the snapshot partition. Each snapshot partition must have the same shared state as the original pool being snapshot.

IMPORTANT: Creating snapshots of clustered NSS pools is not supported.

Snapshots are not supported on RAID1 devices.

When you create a pool's snapshot, you select the device and specify the size to use. You cannot increase the size of the partition later, so make sure you allow sufficient space.

Each snapshot grows as more blocks are changed on the original pool. Theoretically, if all of the original blocks changed, each snapshot's stored-on partition would need to be as big as the original pool. Typically, the disk space needed for each pool snapshot is 10 to 20 percent of the original pool size. The amount of space required depends on the snapshot retention policy and the turnover rate

for data in the original pool. A snapshot should never be allowed to completely fill its stored-on partition. If a snapshot's stored-on partition runs out of space, the copy-on-write blocks cannot be written to it, and write errors occur on the original pool. Allow ample space for the snapshot for the snapshot to grow over time when you specify a size for the snapshot's stored-on partition.

18.2.6 Guidelines for Maintaining the Stored-On Location

The status of any given pool snapshot partition is closely tied to the operational status of the original pool. You can deactivate the original pool, as needed, without adversely impacting the pool snapshot or the status of the stored-on partition. If the original pool is deactive, there are no active transactions for the pool snapshot function to process. For Linux, the stored-on partition hosts only a single snapshot, so it can be safely deactivated after you deactivate its original pool. Make sure that you re-activate the stored-on partition first when bringing the original pool back into service.

In contrast, deactivating the stored-on partition first can cause the ungraceful deactivation of the corresponding original pool.

IMPORTANT: The stored-on partition should remain active as long as it hosts any pool snapshots. You can deactivate it safely after its original pool is deactivated, and for the duration of the pool's deactivation. Activate the stored-on partition before re-activating the original pool.

18.2.7 Guidelines for Onlining Pool Snapshots

For pool snapshots, Online and Offline are conditions related to the visibility of the pool snapshot to users. The pool snapshot is offline by default. The snapshot functions are working in the background to capture any changes being made to the original pool whether the pool is offline or online.

You activate a pool snapshot as a pool by bringing it *online* whenever you want to access the data on it, such as for data retrieval and data backup. After the pool snapshot is online, it appears by its snapshot name in the pool list. Treat it as you would any pool to activate and mount its volumes. Because you are working with a snapshot and not the original pool and its volumes, other management tasks are limited.

The names of volumes on the pool snapshot are a modified version of the volumes on the original pool. By default, the characters *_SV* (snapshot volume) are appended to the volumes' names. When you deactivate the pool snapshot, the corresponding snapshot volumes are automatically deactivated, and the pool snapshot is no longer listed in the pool list.

The Pool object and Volume object for a snapshot are not automatically created in NetIQ eDirectory when you bring an NSS volume snapshot online. These objects are needed only if you want to verify the NSS metadata information on a snapshot volume. For this case, you must create the objects manually by using the **Update eDirectory** option to create the storage objects for the online snapshot NSS pool and each of its volumes. For information, see Section 16.15, "Updating eDirectory Pool Objects," on page 230 and Section 19.5, "Updating eDirectory Volume Objects," on page 271.

If you reboot the server while a pool snapshot is online, the snapshot might be online or offline after the restart, depending on the platform. If the pool snapshot is online when the server goes down, the pool snapshot is automatically set in the Offline state after a reboot.

For instructions, see Section 18.7, "Onlining or Offlining a Pool Snapshot," on page 255.

18.2.8 Guidelines for Deleting Pool Snapshots

Delete pool snapshots as follows:

- Delete all pool snapshots before you move devices that contain the original pool from NetWare to Linux. Different technologies are used for pool snapshots on Linux and NetWare, so existing pool snapshots cannot be used on a different platform.

  WARNING: Without first deleting the pool's snapshots, you might not be able to access or manage the original pool after you move the pool's device cross-platform.

- Delete a pool snapshot when you no longer need it.
- Delete a pool snapshot when you need free space on the device where the stored-on partition exists.

Make sure that the pool snapshot is not mounted as an online pool before you delete it.

Snapshots can be deleted in any sequence.

For instructions, see Section 18.10, "Deleting a Pool Snapshot," on page 259.

18.3 Creating a New Pool Snapshot

- Section 18.3.1, "Prerequisites for Creating a Pool Snapshot," on page 250
- Section 18.3.2, "Using iManager," on page 250
- Section 18.3.3, "Using NSSMU," on page 252

18.3.1 Prerequisites for Creating a Pool Snapshot

- The pool you want to snapshot must already exist and be active.
- Free space must be available on a device that you want to use as the stored-on partition.
- You cannot create snapshots of shared NSS pools. Pool snapshots are not supported for shared pools.
- A pool snapshot must be taken from a physical device that has the same logical sector size as the device containing the original NSS pool.

NOTE: Creating a snapshot of a pool snapshot is not supported.

18.3.2 Using iManager

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

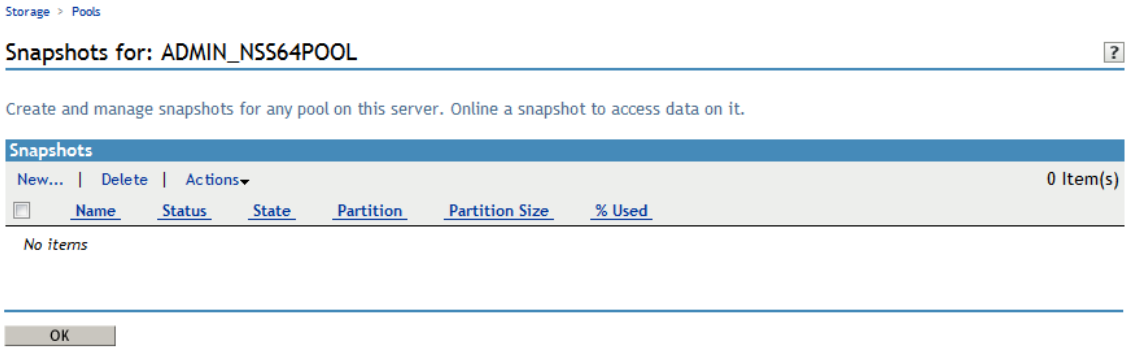
2. In the server field on the **Pools** page, select a server to manage to view a list of pools.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

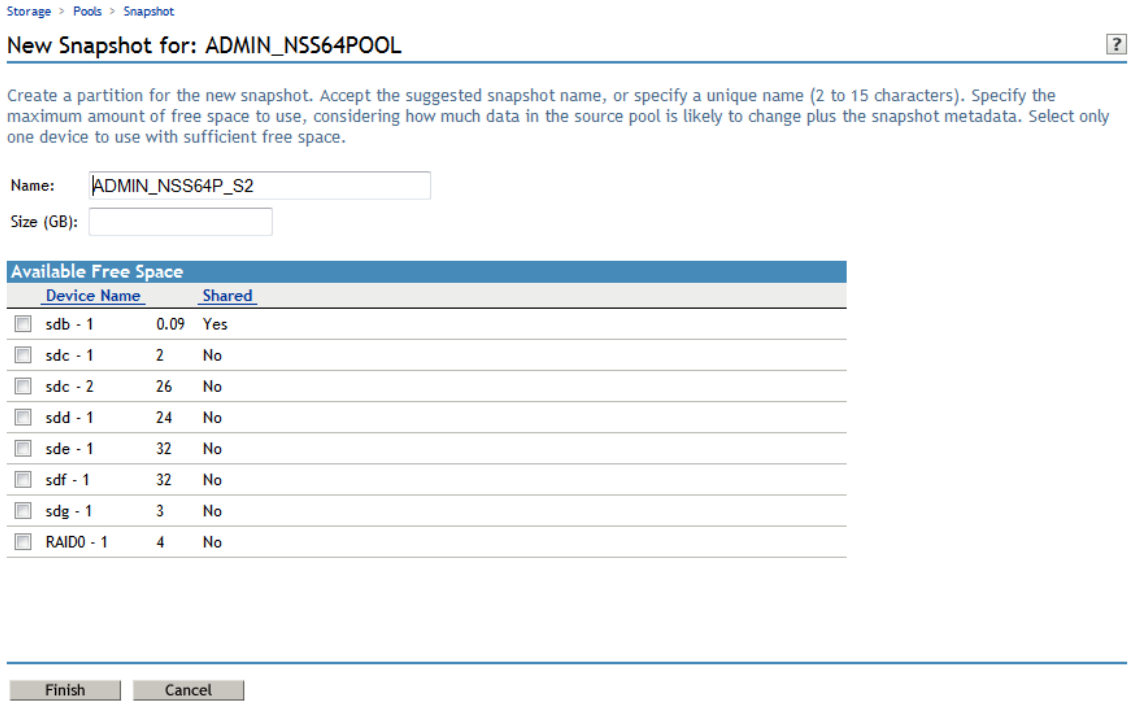
3. If the pool you want to snapshot is not active, select the pool from the **Pools** list, then click **Activate**.

4 In the **Pools** list, select the active pool that you want to snapshot, then click **Snapshot** to go to the **Snapshots for: poolname** page.

IMPORTANT: If the selected pool is a online pool snapshot, the **Snapshot** option is not available. Select the original pool instead.



5 In the **Snapshots** menu, select **New** to open the **New Snapshot for: <poolname>** page.


Storage > Pools > Snapshot
New Snapshot for: ADMIN_NSS64POOL
Create a partition for the new snapshot. Accept the suggested snapshot name, or specify a unique name (2 to 15 characters). Specify the maximum amount of free space to use, considering how much data in the source pool is likely to change plus the snapshot metadata. Select only one device to use with sufficient free space.
Name: ADMIN_NSS64P_S2
Size (GB):
Available Free Space
Device Name
Shared
sdb - 1 0.09 Yes
sdc - 1 2 No
sdc - 2 26 No
sdd - 1 24 No
sde - 1 32 No
sdf - 1 32 No
sdg - 1 3 No
RAID0 - 1 4 No
Finish
Cancel

6 On the **New Snapshot** page, specify the following:

- **Name:** Optionally modify the default snapshot name.

  For information about pool snapshot names, see "Guidelines for Naming Pool Snapshots" on page 247.

- **Size:** Type the amount of free space (in MB) to use for the stored-on partition.

- **Stored-on Partition:** From the list of active devices, select the device where you want to create the stored-on partition.

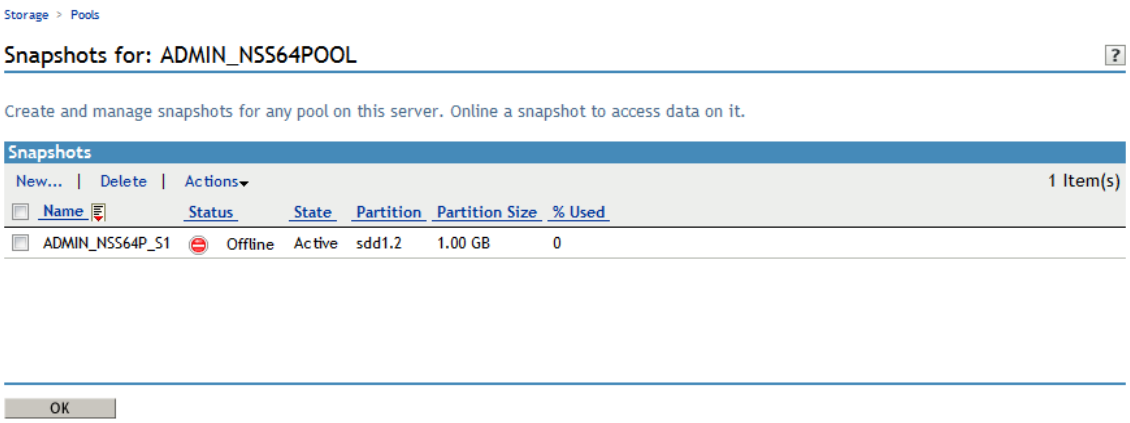
  Each snapshot is stored on a separate partition. The partition for the snapshot cannot be expanded after it is created. If the pool is shared in a cluster, the snapshot feature is not supported. For information, see "Guidelines for Choosing the Stored-On Location" on page 248.

7 Click **Finish** to create the snapshot, or click **Cancel** to back out of the process.

8 After NSS creates the pool snapshot, NSS automatically opens to the **Snapshots** page so that you can further manage the snapshot. The **Snapshots** list contains the newly created snapshot.

IMPORTANT: You might see an error message if the iManager connection to the server you are managing times out before the snapshot is created. The pool snapshot creation should continue on the managed server. If a timeout error occurs, navigate to the **Snapshots** page to view and manage the snapshot.

By default, the snapshot is always **Offline** and **Active**. This means that the snapshot is functioning, but that the pool snapshot is not mounted as an online pool.



18.3.3 Using NSSMU

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter

```
nssmu
```

3 If the pool that you want to snapshot is not currently mounted, mount it now by using your normal mount methods.

4 In NSSMU, select **Snapshot**.

5 Press **Insert** to begin the create process.

6 Specify a name for the pool snapshot.

7 From the **Pools** list, select the pool you want to snapshot, then press **Enter**.

8 From the **Devices** list, select the device where you want to create a partition for the snapshot stored-on partition, then press **Enter**.

Each snapshot is stored on a separate partition, not on a pool.

9 Specify how much space in MB to allocate to the partition.

The partition for the snapshot cannot be expanded after it is created.

10 Press **Enter** to create the snapshot.

The newly created snapshot appears in the **Snapshots** list.

18.4 Viewing a List of Snapshots for a Given Pool

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 In the server field on the **Pools** page, select a server to manage to view a list of pools.

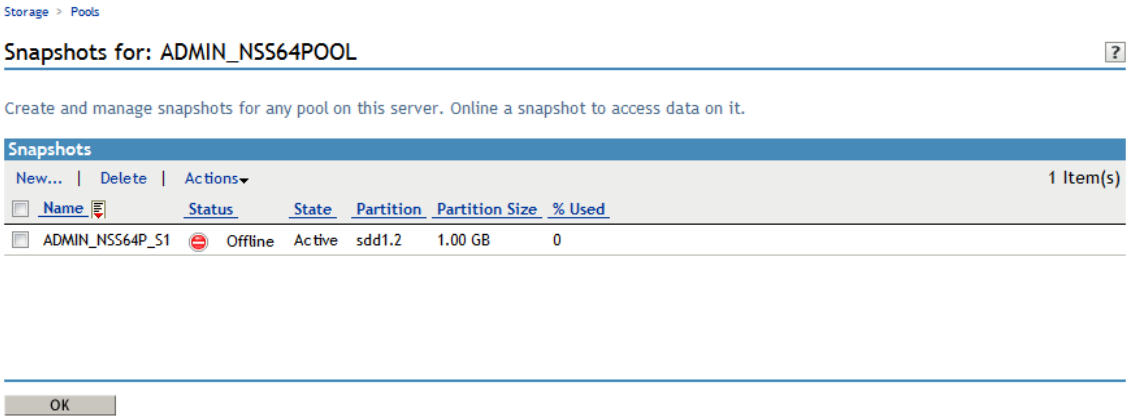
For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 If the original pool for the snapshots you want to view is not active, select the pool from the **Pools** list, then click **Activate**.

4 In the **Pools** list, select the active pool that has snapshots you want to manage, then click **Snapshot** to go to the **Snapshots for: poolname** page.

IMPORTANT: If the selected pool is an online pool snapshot, the **Snapshot** option is not available. Select the original pool instead.

The **Snapshots** report includes the snapshot name, status (**Offline** (default) or **Online**), state (**Active** (default) or **Deactive**), the name and size of the stored-on partition, and the percent of space used on the partition.



18.5 Viewing Pool Snapshot Details

In iManager, you can view the following details about a pool snapshot:

Table 18-2 *Explanation of Pool Snapshot Details*

Snapshot Details	Parameter	Description
Snapshot	Status	Offline (default) or Online. Online pool snapshots appear in the **Pools** page and its snapshot volumes appear in the **Volumes** page.
	State	Deactive (default) or Active. Active indicates that the pool snapshot operation is active. Disabled/Full means the snapshot is invalid because the stored-on partition is full. You should delete the invalid snapshot. Other snapshots continue working. Disabled/Full snapshots are ignored by the pool and do not impact the I/O performance for the pool.
	Size	The current size of the pool snapshot. The pool's snapshot can continue to add metadata for the snapshot until it reaches the size allocated.
	Creation Date	The time stamp that shows the date and time the original pool was snapped.
Snapshot of	Name	The name of the original pool that was snapped.
	Total space	The total space allocated for the original pool.
	Used space	The amount of space currently in use for the original pool.
Stored-On Location (partition)	Name	The partition where the snapshot metadata resides.
	State	The current state of the stored-on partition, either Active (default) or Deactive.
	Total space	The total space allocated for the partition where the snapshot is stored.
	Used space	The amount of space currently in use for the partition where the snapshot is stored.

To view details of a pool snapshot:

1. In iManager, log on to the tree for the server you want to manage.
2. In **Roles and Tasks**, click **Storage > Pools** to open the **Pools** page.
3. Select the server that contains the original pool of the snapshot you want to view.

4 In the **Pools** list, select the original pool of the snapshot you want to view, then click **Snapshot**.

5 On the **Snapshots** page, select the snapshot, then click **Actions > Details** to open the Details dialog box.

18.6 Modifying the Stored-On Location for Snapshots

After you specify a partition to use for a given snapshot, that partition cannot be changed or resized. When you delete the snapshot, the stored-on partition is also deleted.

18.7 Onlining or Offlining a Pool Snapshot

You can mount a pool snapshot as a pool in order to make the point-in-time versions of the volumes available.When it is mounted, the pool snapshot appears on the **Pools** page by its snapshot name. The volumes on the pool appear on the **Volumes** page with an _SV appended to the name, such as V0L1_SV.

For example, you might want to mount a snapshot as a pool to back up data from the snapshot version of the volumes. Snapshot functions occur while the snapshot pool is active, whether the snapshot is mounted or dismounted. Snapshots are typically not mounted for general user access purposes.

- Section 18.7.1, “Using iManager to Online a Pool Snapshot,” on page 255
- Section 18.7.2, “Using iManager to Offline a Pool Snapshot,” on page 256
- Section 18.7.3, “Using NSSMU to Online or Offline a Pool Snapshot,” on page 256

18.7.1 Using iManager to Online a Pool Snapshot

You can use iManager to online or offline pool snapshots.

1 In iManager, log on to the tree for the server you want to manage.

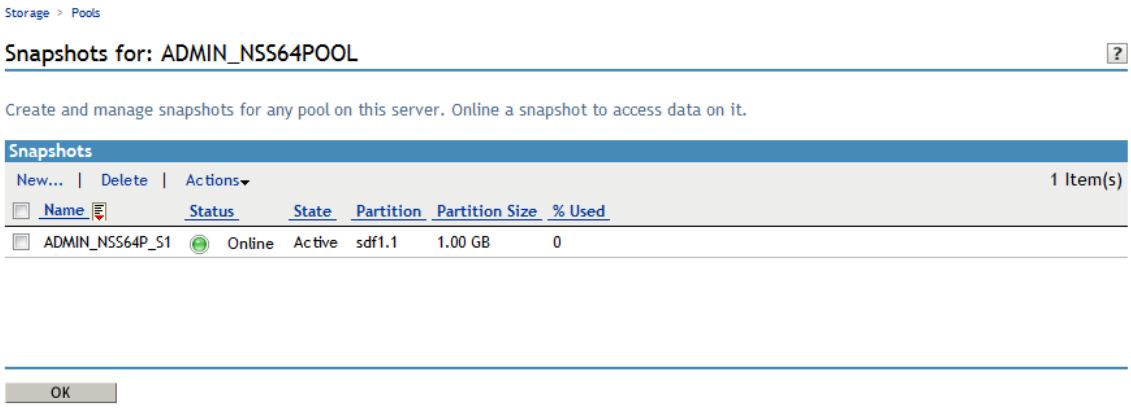
2 In **Roles and Tasks**, click **Storage > Pools** to open the **Pools** page.

3 Select the server that contains the original pool of the snapshot you want to manage.

4 In the **Pools** list, select the original pool of the snapshot you want to manage, then click **Snapshot** to open the **Snapshots** page.

5 Select one or more pool snapshots that you want to manage, then click **Actions > Online**.

This activates the selected pool snapshots and their volumes. The volumes are not mounted automatically.



6 If you need to access a pool snapshot volume, mount the volume.

6a In **Roles and Tasks**, click **Storage > Volumes** to open the **Volumes** page.

6b If you need to verify NSS metadata information for the snapshot volume while it is online, select the snapshot volume, then click **Update eDirectory** to create a Volume object for the volume.

6c On the **Volumes** page, select the snapshot volume you want to manage, then click **Mount**.

18.7.2 Using iManager to Offline a Pool Snapshot

You can use iManager to offline pool snapshots.

1 In iManager, log on to the tree for the server you want to manage.

2 In **Roles and Tasks**, click **Storage > Pools** to open the **Pools** page.

3 Select the server that contains the original pool of the snapshot you want to manage.

4 If the snapshot volumes for the pool snapshot are currently mounted, go to the **Volumes** page, select the mounted snapshot volumes, then click **Dismount**.

5 In the **Pools** list, select the original pool of the snapshot you want to manage, then click **Snapshot** to open the **Snapshots** page.

All snapshot volumes are automatically offlined at this time.

6 Select one or more pool snapshots that you want to manage, then click **Actions > Offline**.

This makes the selected pool snapshots and all the volumes in them unavailable to users. It does not destroy volumes in the snapshots, nor does it destroy the data contained in the volumes.

18.7.3 Using NSSMU to Online or Offline a Pool Snapshot

You can use NSSMU to online or offline the pool snapshot.

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter

```
nssmu
```

3 In NSSMU, select **Snapshot**.

4 Select the pool snapshot that you want to manage, the press **F7** to mount or dismount the pool snapshot.

The pool snapshot functions continue even though the snapshot is not mounted for general user access.

18.8 Viewing and Managing an Online Pool Snapshot

When online, pool snapshots appear and function as a pool in the **Pools** list on the **Pools** page.

1 In iManager, click **Storage > Pools**.

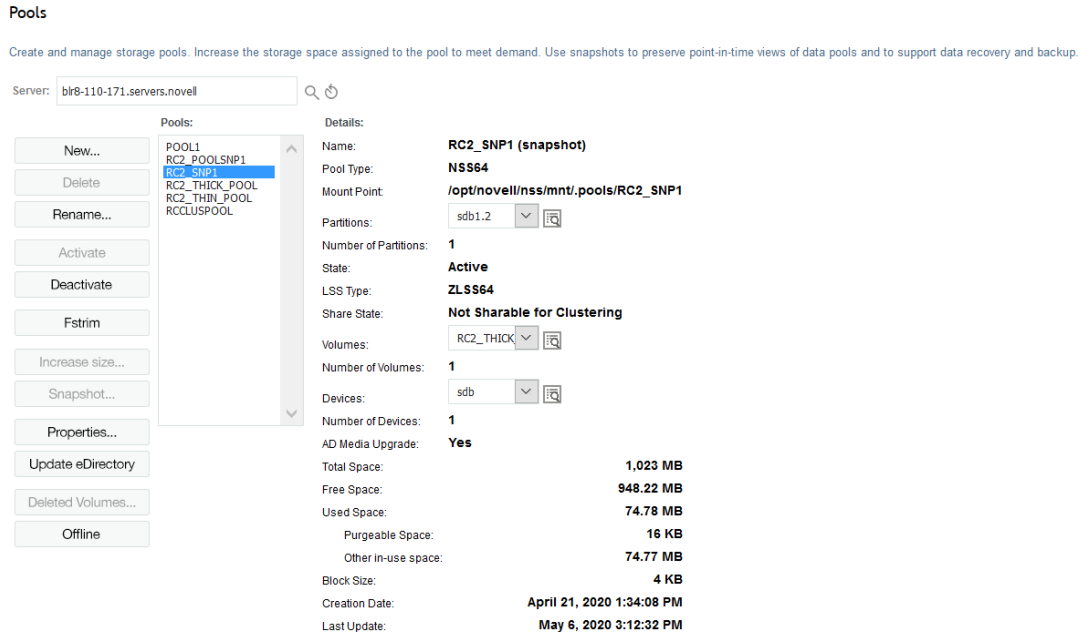
For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage to view a list of its pools.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Pools** list, select the online pool snapshot.

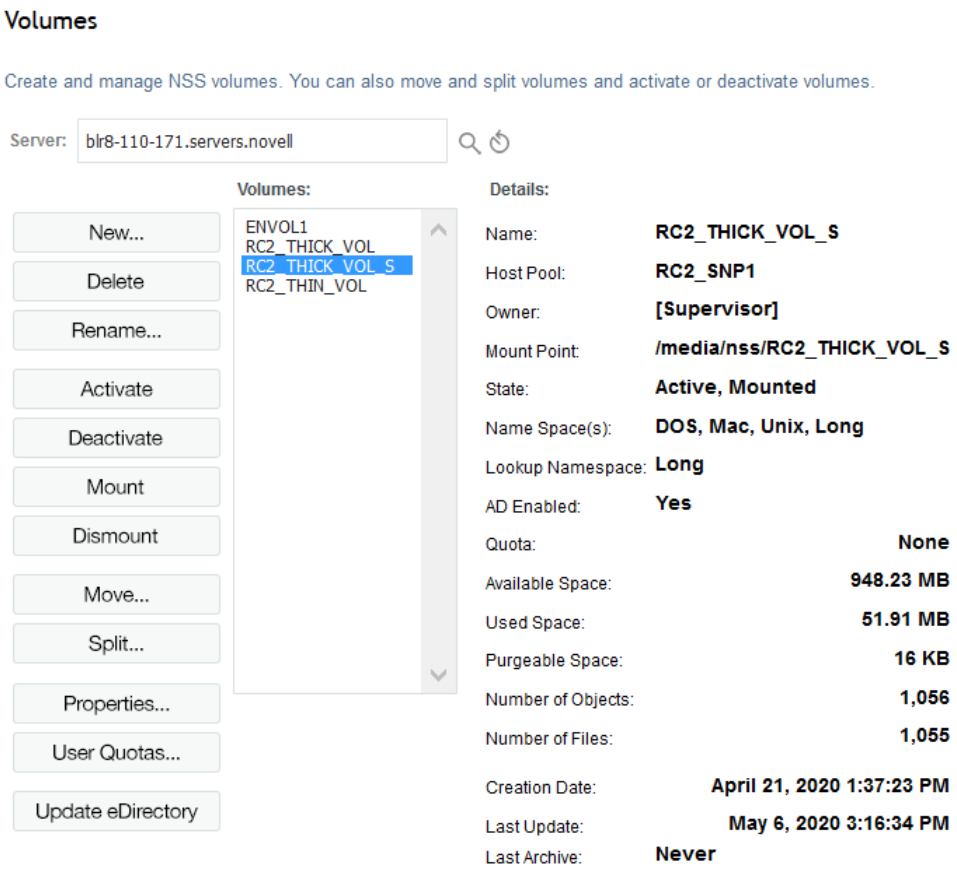
Wait for the page to refresh. It displays the pool snapshot’s details and enables its management options. The Name is followed by **snapshot** in parens to indicate that the selected pool is a snapshot.



4 Click **Storage > Volumes** to go to the volumes page.

The snapshot volumes are listed in the **Volumes** list. They are deactive and unmounted by default.

5 Optionally select the snapshot volume, then click **Mount** to mount the snapshot volume so that you are able to access its data.



6 When you are done, go to the **Pools** page, select the snapshot pool, then click **Offline** to take the pool snapshot offline and dismount its snapshot volumes.

18.9 Restoring Data from an Online Pool Snapshot

You can restore a point-in-time version of data from a pool snapshot by manually copying the data from an online snapshot volume to another location.

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage to view a list of its pools.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 Online the pool snapshot that contains the version of the file you want to restore.

For information, see Section 18.7.1, “Using iManager to Online a Pool Snapshot,” on page 255.

4 Select **Storage > Volumes** to go to the volumes page.

5 Select the snapshot volume (such as V0L1_SV) from the **Volumes** list, then click **Mount**.

Snapshot volumes are mounted Read Only. You cannot modify the content of files on the snapshot.

6 Use any normal method to copy the file of interest from the mounted snapshot volume to a new location.

18.10 Deleting a Pool Snapshot

Use the Delete option to permanently remove one or more selected pool snapshots from the server. Deleting a pool snapshot removes the ownership of the space it occupied, freeing the space for reassignment. For guidelines, see "Guidelines for Deleting Pool Snapshots" on page 250.

IMPORTANT: Delete the oldest snapshot first in a first-created, first-deleted manner.

- Section 18.10.1, "Using iManager to Delete a Pool Snapshot," on page 259
- Section 18.10.2, "Using NSSMU to Delete a Pool Snapshot," on page 259

18.10.1 Using iManager to Delete a Pool Snapshot

1 In iManager, click **Storage > Pools**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 In the server field on the **Pools** page, select a server to manage to view a list of its pools.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3 If the pool that has snapshots you want to manage is not active, select the pool from the **Pools** list, then click **Activate**.

4 If a pool snapshot for the selected pool is currently online, do the following to offline the pool snapshot:

4a If the snapshot volumes for the pool snapshot are currently mounted, go to the **Volumes** page, select the mounted snapshot volumes, then click **Dismount**.

4b On the **Pools** page, select the pool snapshot from the **Pools** list, then click **Offline**.

5 On the **Pools** page, select the active pool from the **Pools** list that has snapshots you want to manage, then click **Snapshot** to go to the **Snapshots for: <poolname>** page.

IMPORTANT: If the selected pool is a online pool snapshot, the **Snapshot** option is not available. Select the original pool instead.

---

6 In the **Snapshots** list, select one or more snapshots that you want to delete.

7 Click **Delete**, then click **Yes** to confirm the delete.

18.10.2 Using NSSMU to Delete a Pool Snapshot

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter

```
nssmu
```

3 If the pool that has snapshots you want to manage is not active, select **Pools** from the main menu, select the pool, then press F7 to activate the pool.

4 In NSSMU, click **Snapshots**.

5 If the pool snapshot you want to delete is currently online, select the pool snapshot from the **Snapshots** list, the press F7 to dismount the pool.

6 Select the pool snapshot that you want to delete from the **Snapshots** list, then press **Delete** to delete the snapshot.

7 Click **Y (Yes)** to confirm the delete.

19 Managing NSS Volumes

OES Storage Services uses storage volumes to logically organize your data. After creating NSS pools, you can create any number of NSS volumes for each pool, depending on the physical space available.

This section describes how to configure and manage NSS volumes by completing the following tasks:

- Section 19.1, “Understanding Volume Properties,” on page 261
- Section 19.2, “Guidelines for NSS Volumes,” on page 266
- Section 19.3, “Creating Unencrypted NSS Volumes,” on page 268
- Section 19.4, “Configuring Encrypted NSS Volumes with NSSMU,” on page 271
- Section 19.5, “Updating eDirectory Volume Objects,” on page 271
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19.1 Understanding Volume Properties

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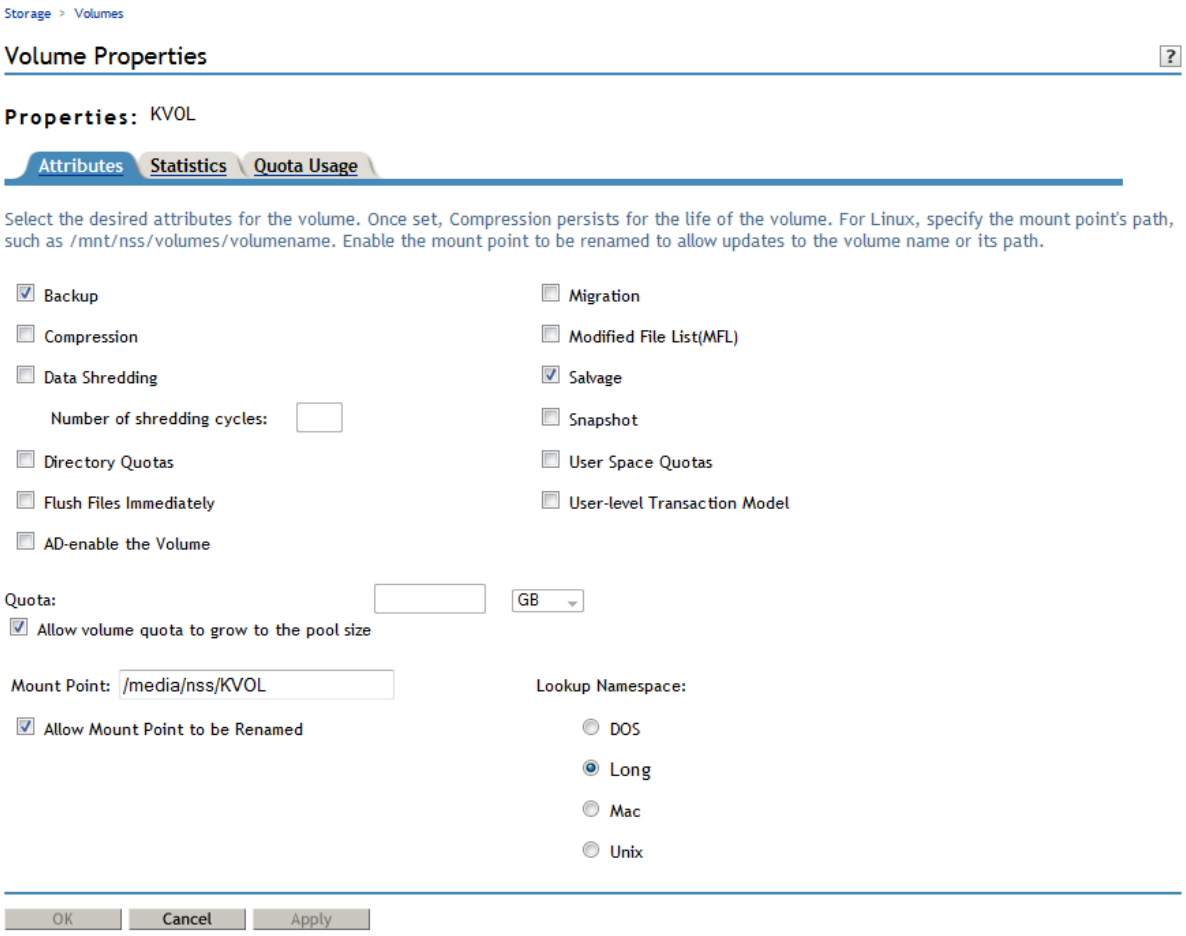
19.1.1 Volume Attributes

Figure 19-1 shows the volume attributes for an NSS volume that can be set in iManager when you create volumes. An explanation of each attribute is provided below.

Figure 19-1 *Volume Attributes*



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- "Data Shredding" on page 263
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- "User-Level Transaction Model (NetWare Only)" on page 265

- "Mount Point" on page 265
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Backup

The Backup attribute sets a flag to indicate to the backup software that the volume contains data you want to back up. Disable this flag if the volume is empty or if backing up the data is unnecessary. This backup flag is independent of the third-party backup system you use; your backup system might not recognize this option, even if you select it. The Backup attribute is enabled by default.

Compression

The Compression attribute activates file compression in NSS volumes. Compression can be activated at creation time only and this choice persists for the life of the volume. Data in the volume might be stored normally or in compressed form, depending on how frequently it is used. Compression parameters can be set at the server level to control compression behavior. For information, see "Managing Compression on NSS Volumes" on page 319.

Data Shredding

The Data Shredding attribute allows you to electronically overwrite deleted and purged data areas to prevent unauthorized users from using a disk editor to access purged files. You can specify the number of times (1 to 7) to shred data. For information, see Section 21.3, "Using Data Shredding to Prevent Access to Purged Files," on page 312.

Directory Quotas

The Directory Quotas attribute enables you to assign a maximum quota of space that a directory can consume. For information, see "Managing Space Quotas for Volumes, Directories, and Users" on page 337.

Flush Files Immediately (NetWare)

The Flush Files Immediately attribute enables NSS to immediately write to disk all data in cache that is pending writes to the file when you close the file. Otherwise, the data in cache must wait until the next write cycle to be written to the disk, putting the information at risk for loss during the interim, for example, if the server failed. For information, see "Enabling Flush Files Immediately to Write Data to the Disk on Close" in the *NW 6.5 SP8: NSS File System Administration Guide*.

IMPORTANT: On Linux, a group write function controls how writes to disk occur. For information, see Section 28.3, "Configuring or Tuning Group I/O," on page 396.

AD-enable the Volume

Choose this option to AD-enable the selected volume. For a volume (both NSS32 and NSS64) to be accessible to the AD users, it should be part of a pool that is AD media upgraded, and it should be AD-enabled.

Migration (to Third-Party Near-Line or Offline Storage)

The Migration attribute sets a flag that indicates to third-party software that this volume's data can be migrated to near-line or offline storage media after it is inactive for specified lengths of time. This attribute requires third-party software to take advantage of the capability.

Modified File List

The Modified File List (MFL) attribute enables NSS to create a list of all files modified since the previous backup. The log is available only through third-party software.

NOTE: This feature is seldom-used since the introduction of the Event File List support. Consider using the Event File List instead. For information, see "FileEvents.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services* (http://developer.novell.com/documentation/vfs/vfs__enu/data/bktitle.html).

Salvage Files

The Salvage Files attribute enables deleted files to remain on the volume until the Purge Delay time expires or until space is needed on the volume for other data. Until the Purge Delay time expires, the Salvage feature tracks the deleted files and allows the deleted files to be salvaged and restored. If space is needed, the oldest deleted files are purged to clear space. Salvage is enabled by default.

If the Salvage Files attribute is disabled, deleted files are purged immediately on deletion.

IMPORTANT: The Salvage Files attribute does not affect whether deleted volumes can be salvaged or purged. Salvage for deleted volumes is determined at the server level with the `nss /ImmediatePurgeOfDeletedFiles=<on | off>` setting. For more information, see Section 24.2.2, "Setting the Immediate Purge of Deleted Files for All NSS Volumes," on page 355.

For information, see Chapter 24, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 351.

Snapshot (File-Level)

The File-level Snapshot attribute enables a backup utility to capture the last closed version of a file that is open at the time a backup is in progress. You must manually deactivate the volume, then activate the volume after setting this attribute to let the volume set up the virtual volume for the metadata about file snapshots.

If the File Snapshot attribute is enabled, OES Storage Management Services (SMS) saves the snapshot version of the file to backup media if a file is in use when the backup occurs.

IMPORTANT: Not all third-party backup software can take advantage of the file snapshot attribute, even if you set it.

User Space Quotas

The User Space Quotas (user space restrictions) attribute enables you assign a maximum quota of space that a user's data can consume across all directories in the volume.

For information, see "Managing Space Quotas for Volumes, Directories, and Users" on page 337.

User-Level Transaction Model (NetWare Only)

The User-Level Transaction mode enables the Transaction Tracking System (TTS) function for NSS volumes. TTS logs changes made to a file contents, and protects database applications by backing out transactions that are incomplete because of a system failure.

Mount Point

Specify the mount point for the NSS volume, such as `/media/nss/VOLA`.

The default mount path for NSS volumes is `/media/nss/volumename`, where *volumename* is the name of the volume. You can optionally specify another path as the mount point.

Allow Mount Point to Be Renamed: Select this option if you want to allow the mount point to be renamed if the volume is renamed.

This feature works only if the volume is mounted in its default location (`/media/nss/volumename`). For example, you have a volume `VOL1` and the default mount point location is `/media/nss/VOL1`. For this volume, you have selected the option **Allow Mount Point to be Renamed**.

You renamed `VOL1` to `MYVOL`, the default mount point after renaming becomes as `/media/nss/MYVOL`.

Lookup Namespace

NSS provides multiple name spaces for the volume: Long, UNIX, DOS, and Macintosh. The Lookup Namespace attribute sets the primary name space to use when you mount the volume, but all name spaces are available for use by various applications.

For NSS volumes, the Long name space is highly recommended because names on NSS are case insensitive by default. The UNIX name space supports case-sensitive naming.

For OES 2 SP1 and later, Long is also the default name space for NSS volumes. Using the Long name space as primary improves performance over using the UNIX name space, especially if you expect to store millions of files on the volume.

NOTE: In OES 2 and earlier, UNIX was the default name space for mounting NSS volumes on Linux.

NCP tools require only the Long or UNIX be set as the primary name space. With DOS or Mac set as the primary name space, you cannot view or manage the volume from OES Remote Manager, and users are unable to map to the volume using NCP clients. If you use the Long or UNIX name space, the DOS and Mac name spaces are still available, but they are not the primary.

The UNIX name space supports some special characters that are not allowed in the Long name space, such as characters `0x01` through `0x07` and `0x10` through `0x1f`. If you need to use these special characters in filenames, choose UNIX as the default name space.

If you change the name space for an existing shared volume by using NSSMU or the Storage plug-in for iManager, you must modify the load script for the pool cluster resource to add the name space to the ncpcon mount command for the volume. Otherwise, the cluster assumes the default name space for mounting the volume. You can do this by using the `/opt=ns=<long|unix|dos|mac>` switch in the `ncpcon mount` command.

For example, to specify the LONG name space, add the `/opt=ns=long` switch as follows:

```
ncpcon mount /opt=ns=long <VOLUMENAME>=<VOLUMEID>
```

For example, to specify the UNIX name space, add the `/opt=ns=unix` switch as follows:

```
ncpcon mount /opt=ns=unix <VOLUMENAME>=<VOLUMEID>
```

19.1.2 Encryption Support

Encryption provides password-protected activation of encrypted NSS volumes. Encryption can be activated at creation time only, and this choice persists for the life of the volume. Encrypted volume support is available on OES 2 Linux and later.

Encrypted volumes can be created only from NSSMU and NLVM. Encrypted volumes require special handling on the first activation after startup, but all attributes are available for encrypted volumes and are managed the same as for unencrypted volumes. For information about creating and activating encrypted volumes, see “Managing Encrypted NSS Volumes” on page 293.

19.1.3 Enhanced Hard Link Support

Enhanced hard link support for an NSS volume allows users to create multiple names for a single, existing file object in the same directory or in multiple directories in the same NSS volume. NSS supports zero to 65,535 hard links per file on NSS volumes.

After the media upgrade for enhanced hard links support, the Hard Links attribute must be enabled or disabled by using commands. The attribute cannot be enabled or disabled in NSSMU or in iManager. For information about enabling Hard Link support for a volume, see Section 25.3, “Enabling or Disabling the Hard Links Attribute,” on page 368.

After the volume has been enabled for enhanced hard links, you can create hard links. For information about creating and managing hard links, see Chapter 25, “Managing Hard Links,” on page 363.

Beginning in OES 2 SP1, OES Storage Management Services supports the backup and restore of hard links on NSS volumes.

Hard links are lost when you use the Move Volume or Split Volume features of Distributed File Services.

19.2 Guidelines for NSS Volumes

- Section 19.2.1, “Guidelines for Sizing Volumes,” on page 267
- Section 19.2.2, “Guidelines for Name Spaces,” on page 267

- Section 19.2.3, “Guidelines for NSS Volumes in a Cluster,” on page 267
- Section 19.2.4, “Guidelines for NSS Volumes in a Mixed-Node Cluster,” on page 268

19.2.1 Guidelines for Sizing Volumes

NSS volumes are logical storage media that acquire space from pools of storage. When you create a logical volume, you can either assign it a fixed quota as the maximum size, or allow it to expand to the pool size. To grow a volume, you might need to add new segments to grow the pool first, up to the maximum pool size of 8 TB for NSS32 pools and 8 EB for NSS64 pools.

If a pool contains multiple volumes, the cumulative administrative maximum sizes of all volumes can exceed the pool’s maximum size by overbooking, although real total size is bound by physical limitations. Because space is allocated to volumes as needed, a volume might not reach its quota. As the overbooked volumes consume the available physical space, you need to add more disk space to the pool to accommodate the growth, or consider moving or splitting volumes to move data to other pools.

For example, suppose you have an 800 MB storage pool with eight volumes set at 100 MB each. The administrative size equals the physical limits. To overbook the pool, you can add volumes, set one or more of the volumes to expand to the pool size, or increase the size of existing volumes, with the understanding that these are administrative maximum sizes, not physical sizes.

Because volume sizes can be overbooked in a pool, NSS automatically considers what space is remaining in a pool in order to report the maximum size that is currently possible for the volume. In addition to other volumes that can consume space in a pool, NSS snapshots and third-party snapshots can consume space that might not be reported in all of the management tools that report space. NSS reports the total space possible for the volume and the amount of space used by the volume so that tools can properly calculate the maximum free space available.

19.2.2 Guidelines for Name Spaces

NSS recognizes DOS, Macintosh, UNIX, and Long name spaces. Volume names, directory names, and filenames in NSS are case insensitive. This differs from Linux POSIX file systems, which are case sensitive by default. For information, see “Lookup Namespace” on page 265.

19.2.3 Guidelines for NSS Volumes in a Cluster

You must create at least one shared volume in a cluster-enabled pool. Typically, all volumes are created when you initially set up the cluster resource and before you need to cluster migrate or fail over the resource to other servers in the cluster.

The Server, Pool, Volume, Cluster Resource, and Cluster objects are recommended to be in the same context (such as ou=ncs,o=microfocus).

If the objects are in different contexts, you might receive an eDirectory error when you attempt to modify the pool, create or modify the volumes, home directories, Distributed File Services junctions, or any other elements that are managed using eDirectory objects. To resolve the problem, you must cluster migrate the pool cluster resource back to the node where the pool was created in order to perform those management tasks.

19.2.4 Guidelines for NSS Volumes in a Mixed-Node Cluster

In a clustered storage area network with OES Cluster Services, NSS volumes can fail over between kernels, allowing for full data and file system feature preservation when migrating data to Linux. However, you cannot SAN boot cross-platform.

For information about using NSS volumes cross-platform, see the following:

- Section 8.2, “Cross-Platform Issues for NSS Volumes,” on page 85
- Section 8.3, “Cross-Platform Issues for NSS Features,” on page 86
- Section 8.4, “Cross-Platform Issues for File Access,” on page 87

For information about clustering, see the following:

- *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*
- *NW6.5 SP8: Novell Cluster Services 1.8.5 Administration Guide*

19.3 Creating Unencrypted NSS Volumes

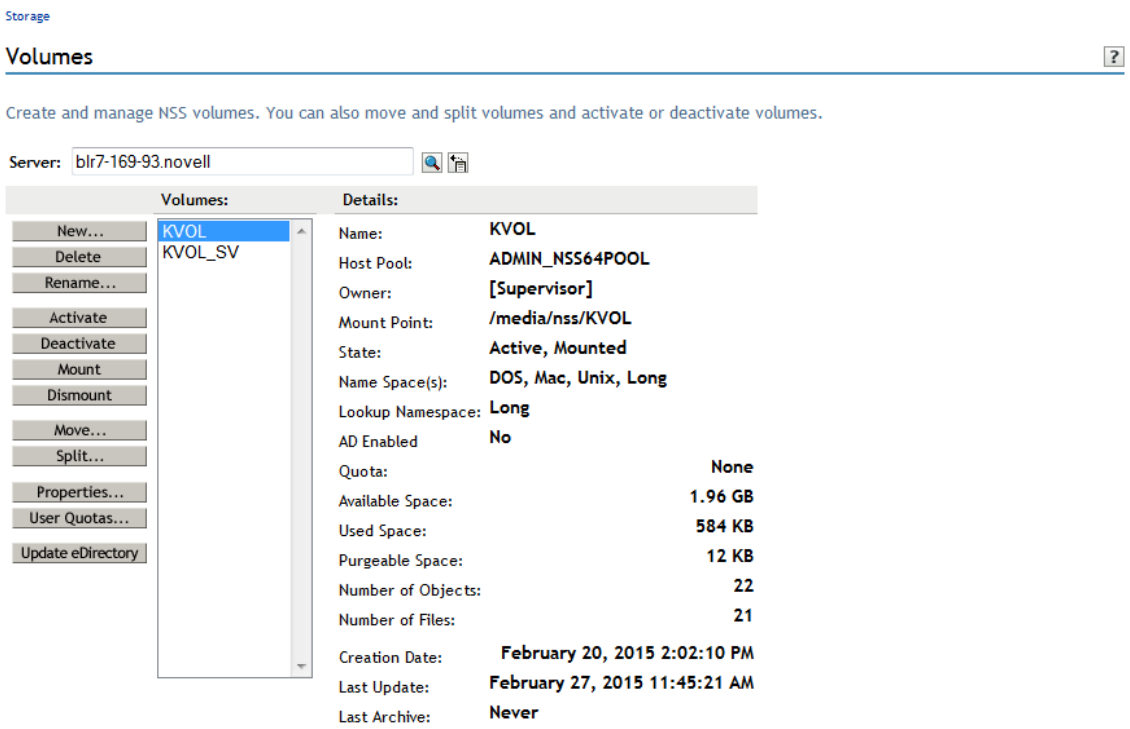
This section describes how to create an unencrypted volume with iManager. Encrypted volumes can be created only in NSSMU. For information on creating encrypted volumes, see “Managing Encrypted NSS Volumes” on page 293.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

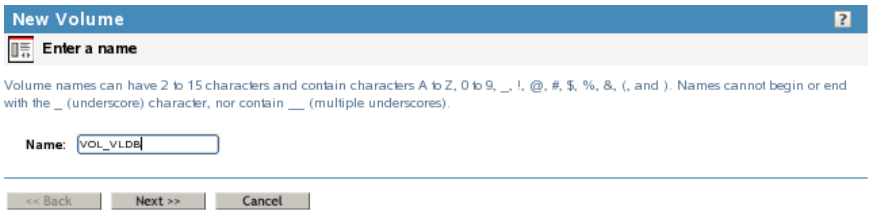
   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

   A list of volumes appears in the **Volumes** list, as illustrated in the following figure.



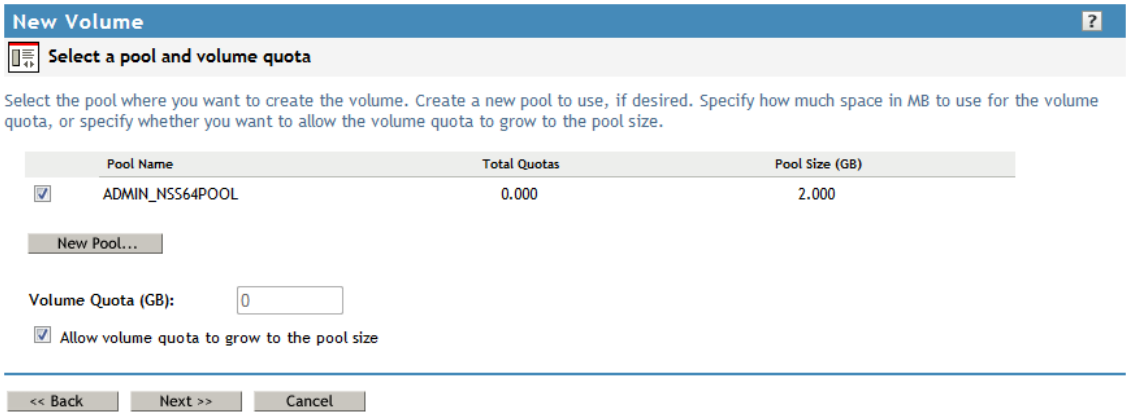
3 To create a new volume, click **New**.

This opens the **New Volume** Wizard to guide you through the process.


New Volume
Enter a name
Volume names can have 2 to 15 characters and contain characters A to Z, 0 to 9, _, !, @, #, $, %, &, (, and). Names cannot begin or end with the _ (underscore) character, nor contain __ (multiple underscores).
Name: VOL_VLDB
<< Back
Next >>
Cancel

4 Specify a name for the new volume, then click **Next**.

If the name you provide is not unique, you receive an error message. For guidelines about naming volumes, see Section 6.4, “Naming NSS Storage Objects,” on page 64.


New Volume
Select a pool and volume quota
Select the pool where you want to create the volume. Create a new pool to use, if desired. Specify how much space in MB to use for the volume quota, or specify whether you want to allow the volume quota to grow to the pool size.
Pool Name
Total Quotas
Pool Size (GB)
ADMIN_NSS64POOL
0.000
2.000
New Pool...
Volume Quota (GB):
0
Allow volume quota to grow to the pool size
<< Back
Next >>
Cancel

5 Do one of the following to specify the pool to use:

- Select an existing pool from the list where you want the new volume to reside.
- If no pools exist, click **New Pool**, create a pool to use, select the pool.
- If existing pools do not have sufficient space for the volume you want to create, click **Cancel** to close the Wizard. You must add more segments of free space to the pool, then return to the **Volumes** page to create the new volume.
- If no pools exist and no space is available to create one, click **Cancel** to close the Wizard. You must add more devices to the server or free up space on existing pools, then return to the Volumes page to create the new volume.

6 Specify the size of the volume:

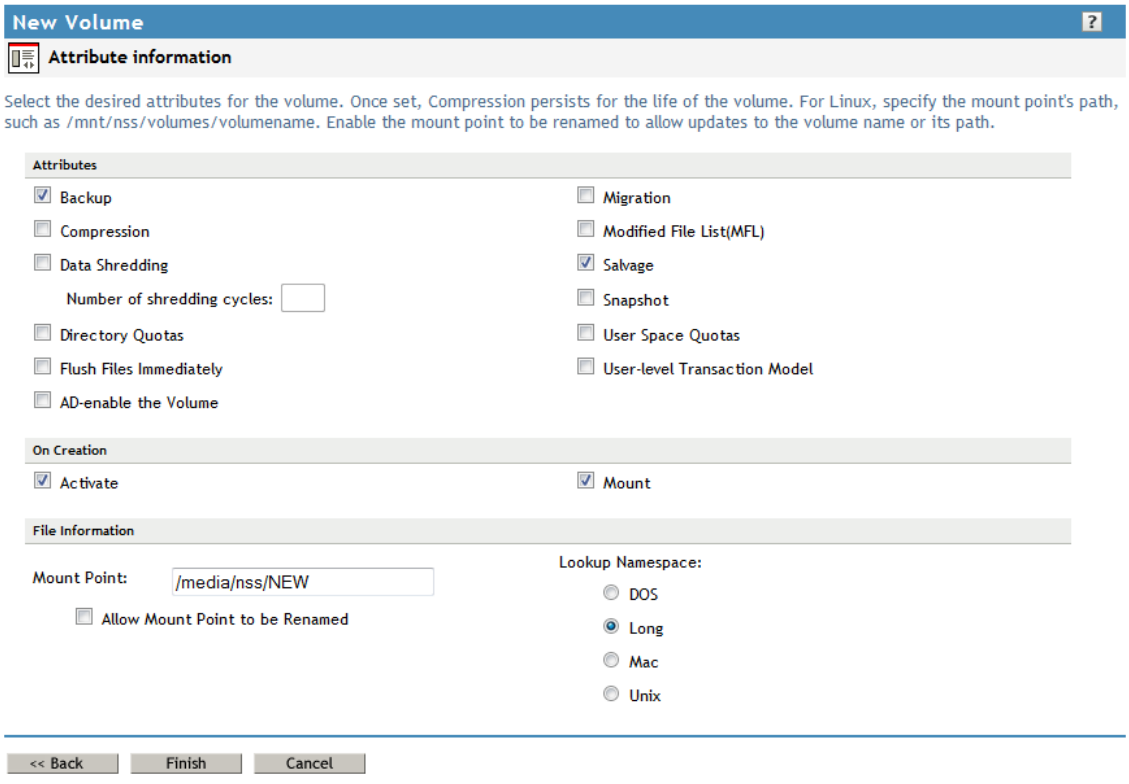
- **No Volume Quota:** Select **Allow Volume Quota to Grow to the Pool Size** if you want the volume to expand to the size of the pool. This is the default.

  Pools can be overbooked; each volume can potentially grow to the size of the pool. NSS allocates space as it is needed.
- **Volume Quota:** Deselect **Allow Volume Quota to Grow to the Pool Size**, then type a **Volume Quota** size in MB for the volume if you want to limit the size of the volume.

7 Click **Next**.

8 On the **Attribute Information** page under the **Attributes** section, set the attributes for the new volume you are creating. The Backup and Salvage attributes are selected by default.

For information about volume attributes, see Section 19.1, “Understanding Volume Properties,” on page 261.



9 On the **Attribute Information** page under the **On Creation** section, set the following preferences:

- **Activate**. Activates logical volumes as soon as you create them.
- **Mount**. Mounts logical volumes as soon as you create them.

10 On the **Attribute Information** page under **File Information**, specify the following parameters:

- **Mount Point:** For a Linux server, specify the mount point for the NSS volume, such as `/media/nss/VOLA`.

  The default mount path for NSS volumes is `/media/nss/volumename`, where *volumename* is the name of the volume. You can optionally specify another path as the mount point.
- **Allow Mount Point to Be Renamed:** Select this option if you want to allow the mount point to be renamed if the volume is renamed.

  This feature works only if the volume is mounted in its default location (`/media/nss/volumename`).
- **Lookup Name Space:** Select the name space to use when you mount the volume. The name spaces are UNIX, Long, DOS, or Macintosh. The default name space is Long.

  The recommended setting is Long. This setting ensures that filenames are case insensitive whether the volume is mounted. It also improves performance over using UNIX, especially if you expect to store millions of files on the volume.

11 Click **Finish**.

12 If you enabled the **Directory Quotas** attribute, restart NCP2NSS by entering at a terminal prompt:

```
systemctl restart ncp2nss.service
```

19.4 Configuring Encrypted NSS Volumes with NSSMU

NSS Encrypted Volume Support allows you to create encrypted NSS volumes using NSSMU. For information, see "Managing Encrypted NSS Volumes" on page 293.

19.5 Updating eDirectory Volume Objects

In NetIQ eDirectory, each NSS volume is represented by a Volume object. Volume objects are leaf objects that represent a physical or logical volume on the network.

The Volume object's properties contains the following information:

- The server where the volume resides
- The volume name recorded when the volume was initialized on the server
- The volume's owner (login username of the administrator who created it)
- Space use restrictions for users
- A description of the volume's use
- Statistical information on disk space availability, block size, directory entries, name space support, and so on.

Usually, NSS creates the NetIQ eDirectory Volume object when you create the volume, and it updates the properties of the volume as needed. The **Update eDirectory** option on the Volumes page allows you to add or replace a Volume object for a selected volume at the same context level as the server.

IMPORTANT: When you delete (or delete and replace) a Volume object in eDirectory, the home directory attribute is removed in the User objects for any users that reference that Volume. The home directory attribute points to a particular Volume object. When that Volume object is deleted, eDirectory needs to clean up all references to the object being deleted.

When you select Update eDirectory, NSS searches for the object.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select the volume you want to update.

   Wait for the page to refresh and display the details.
4. Click **Update eDirectory**.

   Wait while NSS searches for the Volume object in the server context.
5. Do one of the following:
   - If the Volume object does not exist, NSS adds the Volume object to the context level. Confirm the addition.
   - If the Volume object exists, NSS prompts you with two options: Delete and Replace the existing object or Retain the existing object. Select one option and confirm your choice.

19.6 Viewing the Details of an NSS Volume

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select a volume that you want manage.

   When the page refreshes, the details for the volume appear in the **Details** area. The volume must be mounted and active for the details to be available.
4. (Conditional) Activate the volume, select the volume, then click **Activate**.

19.7 Viewing Properties of an NSS Volume

After you set up and configure NSS volumes, you can view the properties, such as attribute settings, volume statistics, and volume usage.

1. In iManager, click **Storage > Volumes**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

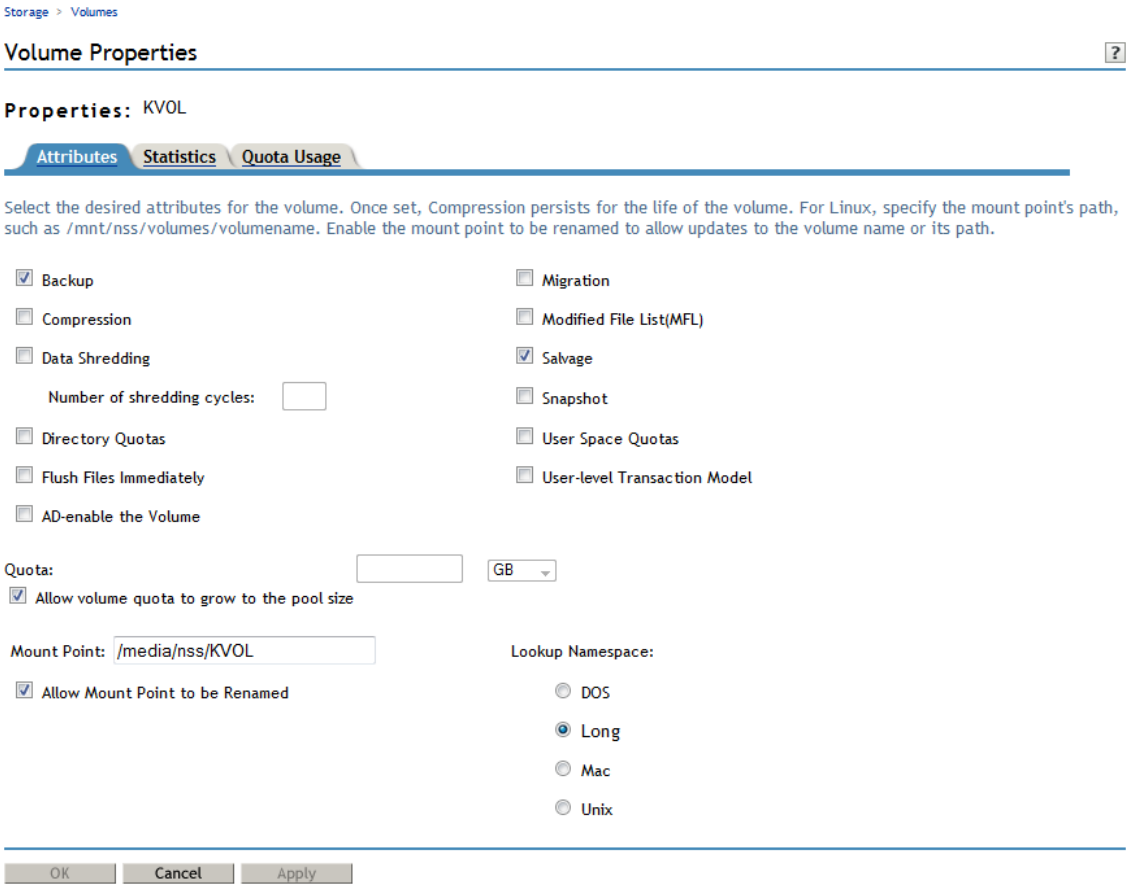
2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Volumes** list, select a volume that you want manage.

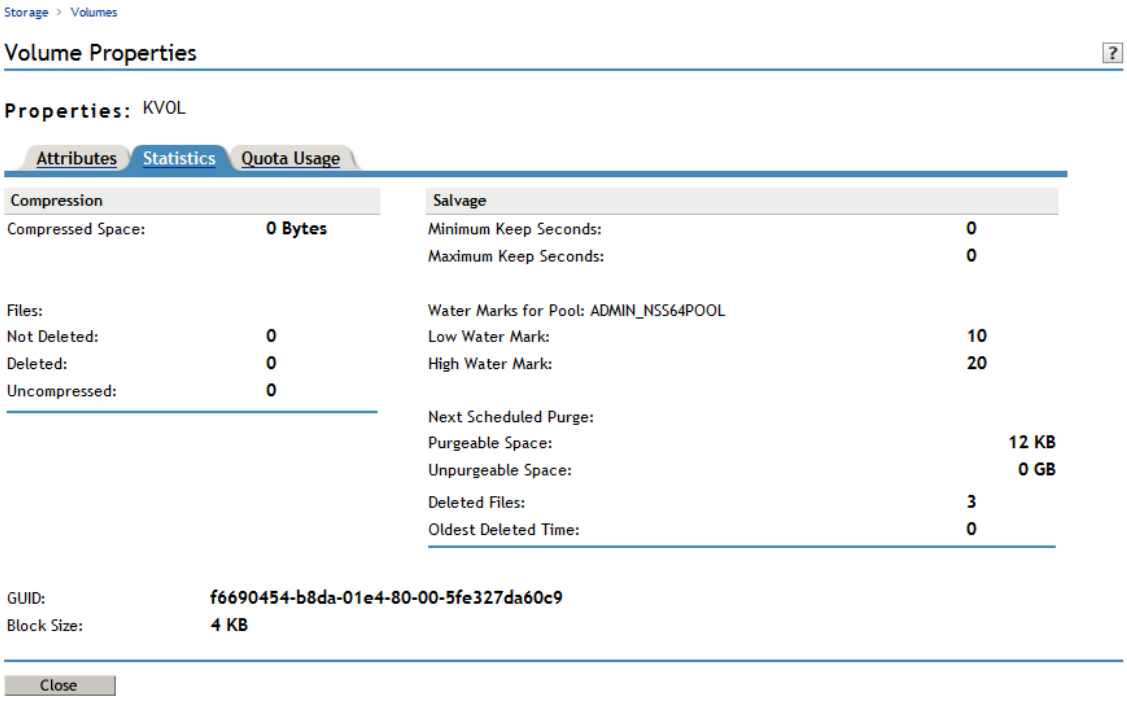
4 Click **Properties**.

The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens by default to the **Attributes** tab.



Use the **Attributes** page to view the volume’s attribute configuration, the volume quota, and the volume mount point. For information about modifying attributes, see Section 19.8, “Modifying Attributes of an NSS Volume,” on page 275.

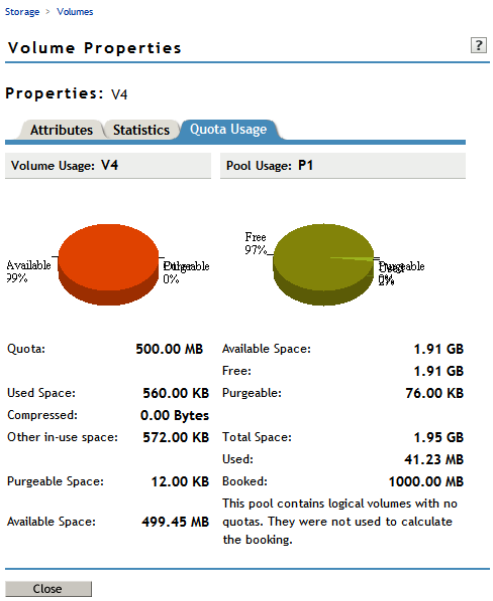
5 Click the **Statistics** tab to view the current space usage statistics for the selected volume.



If the Salvage attribute is enabled, values are displayed for the salvage parameters. The low and high watermark displays the default settings for the pool-level watermarks for the pool where the volume resides. For information about managing salvage parameters, see Chapter 24, “Salvaging and Purging Deleted Volumes, Directories, and Files,” on page 351.

If the Compression attribute is enabled, statistics are displayed for the compression data. For information about configuring compression parameters, see Chapter 22, “Managing Compression on NSS Volumes,” on page 319.

6 Click the **Quota Usage** tab to view the volume and pool space usage for the selected volume.



19.8 Modifying Attributes of an NSS Volume

After you set up and configure NSS volumes, you can modify most of the attribute settings. The Encrypted Volume Support attribute and the Compression attribute can be set only at the time the volume is created. If you try to modify those settings, iManager or NSSMU returns an error message.

You can also specify a Volume Quota or modify the mount point.

1 In iManager, click **Storage > Volumes**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Volumes** list, select a volume that you want manage.

4 Click **Properties**.

The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. Use the **Attributes** page to view or modify the attributes for the selected volume.

5 Do one or more of the following:

- Select or deselect a modifiable attribute, then click **Apply**.

  The Encryption and Compression attributes can be set only at the time the volume is created. If you try to modify those settings, iManager returns an error message.

  For information about attributes, see Section 19.1, “Understanding Volume Properties,” on page 261.

- Specify a volume quota, then click **Apply**.
- Specify the default **Lookup Namespace** to use when mounting the volume, then click **Apply**.

  The next time the volume is mounted, this will be the name space used. The default name space is Long.

- Specify a new **Mount Point** for your volume, then click **Apply**. For example:

  ```
  /media/nss/VOL1
  ```

6 If you enabled or disabled the **Directory Quotas** attribute, restart NCP2NSS by entering at a terminal prompt:

```
systemctl restart ncp2nss.service
```

For information about setting quotas after you have enabled the Directory Quotas attribute or User Space Quotas attribute, see “Managing Space Quotas for Volumes, Directories, and Users” on page 337.

19.9 Modifying the NSS Volume Size

1 In iManager, click **Storage > Volumes**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

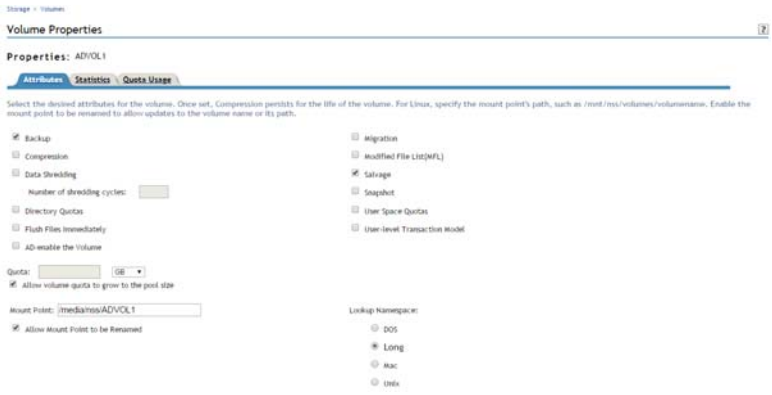
2 Select a server to manage.

For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3 In the **Volumes** list, select a volume that you want manage.

4 Click **Properties**.

The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens to the **Attributes** tab.



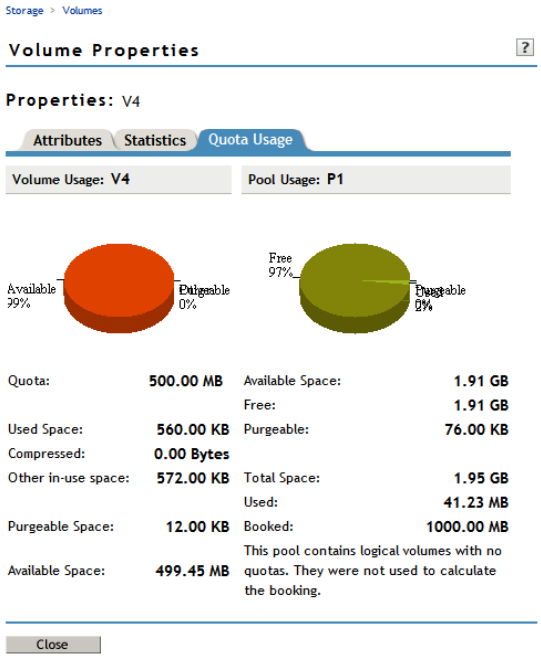
5 In the **Quota** field, do one of the following:

- **No Quota:** Select **Allow Volume Quota to Grow to the Pool Size**. NSS pools allow overbooking so the administrative sum of all volumes' quotas in a pool can exceed the physical pool quota.
- **Quota:** Deselect **Allow Volume Quota to Grow to the Pool Size**, then specify the maximum size you want to allow volume to grow. The quota cannot exceed the pool size.

  If you set a quota that is less than the volume's current size, no files can be saved to the file until you purge files to make room on the volume.

6 Click **Apply**.

7 Click the **Quota Usage** tab to view the volume and pool space usage for the selected volume and to verify the new setting.



19.10 Configuring the Name Space for an NSS Volume

NSS supports the Long, DOS, UNIX, and Macintosh name spaces. By default, names on the NSS file system are case insensitive, which is supported by the Long name space. The Long name space is the default setting used when mounting NSS volumes. In order to mount a volume with a different name space, you must specify the name space explicitly in the mount command, or you can specify the name space to use as a property of the NSS volume.

On Linux POSIX file systems, the UNIX name space is typically used. If your volume contains large directories with millions of files, using the default UNIX name space on NSS volumes can cause volumes to mount very slowly. Using the Long name space allows the NSS volume to mount normally. Unless you need to support case sensitive filenames, we strongly recommend using the Long name space.

The preferred name space can be set when you create the volume and set its attributes, or at any time by modifying the Lookup Namespace attribute in the volume's properties.

You can also mount the volume by specifying the name space to use as an option of the mount command. For instructions, see Section 19.11, "Mounting NSS Volumes with Linux Commands," on page 278.

To view or modify the Lookup Namespace attribute for the NSS volume:

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select a server to manage to view a list of its volumes.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.
3. In the **Volumes** list, select a volume that you want manage.
4. Click **Properties** to view the volume's properties.

   The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**.
5. On the **Attributes** page, view the current setting of the **Lookup Namespace** for the selected volume.
6. On the **Attributes** page, optionally modify the **Lookup Namespace** to use by selecting the radio button next to it.
   - **Long** (recommended, default)
   - **DOS**
   - **UNIX**
   - **Mac**

   This is the new value that is applied automatically whenever you mount the volume.
7. Click **Apply** to save your changes.
8. On the **Volumes** page, click **Dismount** to unmount the volume.

   Wait until the volume unmounts gracefully before continuing.
9. On the Volumes page, click **Mount** to mount the volume to mount it the new name space.
10. If you change the name space for an existing shared volume by using NSSMU or the NSS plug-in for iManager, you must modify the load script for the pool cluster resource to add the name space to the ncpcon mount command for the volume. Otherwise, the cluster assumes the

default name space for mounting the volume. You can do this by using the `/opt=ns=<long|unix|dos|mac>` switch in the ncpcon mount command. After you modify the load script, you must take the pool cluster resource offline, then bring it online to apply the new name space setting for the volume.

For example, to specify the LONG name space, add the `/opt=ns=long` switch as follows:

```
ncpcon mount /opt=ns=long <VOLUMENAME>=<VOLUMEID>
```

For example, to specify the UNIX name space, add the `/opt=ns=unix` switch as follows:

```
ncpcon mount /opt=ns=unix <VOLUMENAME>=<VOLUMEID>
```

For more information, see "Configuring a Load Script for the Shared NSS Pool" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

19.11 Mounting NSS Volumes with Linux Commands

When mounting an NSS volume, specify the Long name space to make its directory names and filenames case insensitive. Long is the default name space, and improves performance over using the UNIX name space. If your volume contains large directories with millions of files, using the UNIX name space can cause volumes to mount very slowly and can degrade performance.

Mounting an NSS Volume

To mount an NSS volume from a terminal command line, enter

```
mount -t nssvol volname mount_point -o name=volname,ns=long
```

For the `-t` option, *`nssvol`* is the file system type for NSS volumes. *`Volname`*is the name of the NSS volume.

The *`mount_point`* is the full path with the volume name where you want to mount the volume, such as `/media/nss/VOL1`. The default mount location for NSS volumes is in the `/media/nss/` directory.

For the `-o` option, specify the volume name and the primary name space type. Valid name space options are `dos`, `mac`, `long`, or `unix`.

For example, to mount an NSS volume named VOL1 as case insensitive, enter the following at a terminal prompt:

```
mount -t nssvol VOL1 /media/nss/VOL1 -o name=VOL1,ns=long
```

Mounting an NSS Volume Automatically on System Reboot

You can automatically mount the NSS volume on system reboot by adding a line to the `/etc/fstab` file in the following general format:

```
label mount_point fstype mount_options dump_frequency fsck_order
```

For example:

```
VOL1 /media/nss/VOL1 nssvol noauto,rw,name=VOL1,ns=long 0 0
```

19.12 Renaming an NSS Volume

You can rename NSS volumes. For example, you might want to change the name of a volume to reflect the department or organization that uses it.

1. In iManager, **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select a volume.
4. Click **Rename**.

   The Rename Volume Wizard opens.
5. Specify the new name of the volume.
6. Click **Finish**.

   After the page refreshes, the volume appears in the **Volumes** list with its new name.

19.13 Renaming (Modifying) the Mount Point for an NSS Volume

The default mount point for NSS volumes is `/media/nss/volumename`. You must enable the **Allow the Mount Point to Be Renamed** option for the volume to allow the mount point to be renamed.

NOTE: Currently, renaming the mount point is not supported for clustered NSS volumes using NSSMU, NLVM and iManager. For more information on renaming, see “Renaming the Mount Point Path for a Shared NSS Volume (Using a Custom Mount Point for a Shared NSS Volume)” in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

- Section 19.13.1, “Renaming the Mount Point for a New Volume,” on page 279
- Section 19.13.2, “Enabling the Mount Point for the NSS Volume to Be Renamed,” on page 280
- Section 19.13.3, “Renaming the Mount Point for an Existing NSS Volume,” on page 280

19.13.1 Renaming the Mount Point for a New Volume

The default mount point for NSS volumes is `/media/nss/volumename`. You can specify a different mount point (that is, modify the volume’s directory path) as you create the volume if you create the volume in iManager. Creating the volume in the NSSMU (`nssmu`) does not allow for the mount point to be changed during the volume setup, but you can change it afterwards.

19.13.2 Enabling the Mount Point for the NSS Volume to Be Renamed

The **Allow the Mount Point to Be Renamed** option enables the NSS volume's mount point to be renamed. This option is disabled by default. Enable the option as you create the volume, or enable it at any time for an existing volume by modifying the setting on the **Attributes** page (**Storage > Volumes > Properties > Attributes**) in iManager.

1. In iManager, click **Storage**, then click **Volumes**.
2. Select the server you want to manage to view a list of its volumes.
3. From the **Volumes** list, select the volume, then click **Properties** to view the volume attributes.
4. On the **Attributes** page, select **Allow the Mount Point to Be Renamed**.
5. Click **Apply** to save the change.

19.13.3 Renaming the Mount Point for an Existing NSS Volume

Whenever you change the mount point for an existing NSS volume, you must also restart NetIQ eDirectory to update the NetWare Core Protocol (NCP) Server cache. When an NSS volume is created, the NCP Server gets the path to the volume and caches it, assuming that it never changes. When you later run `ncpcon` and enter the `volume` command, it reports which volumes are still found at their respective mount points. Only the volumes that are still valid as compared to the list in cache are reported. Restarting eDirectory forces the NCP Server volume cache to update, so that the correct path is stored for reporting volume status.

1. Use either iManager or `nssmu` to change the volume's mount point.

   The following instructions are for iManager.

   1a. In iManager, click **Storage > Volumes**.

   1b. Select the server you want to manage to view a list of its volumes.

   1c. From the **Volumes** list, select the volume, then click **Properties** to view the volume attributes.

   1d. If the **Allow the Mount Point to be Renamed** option is not selected, select it and click **Apply**.

   NOTE: Select this option if you want to allow the mount point to be renamed if the volume is renamed. This feature works only if the volume is mounted in its default location (`/media/nss/volumename`).

   1e. In **Mount Point**, type the new mount point.

   The default mount point for NSS volumes is `/media/nss/`*`volumename`*. The new path should also include the *volumename*.

   `/mnt/nss/volumes/`*`volumename`*

   1f. Click **Apply** to save the change.
2. Open a terminal console on the server, then log in as the `root` user or equivalent.
3. Restart eDirectory by entering

   ```
   systemctl restart ndsd.service
   ```

   Restarting eDirectory causes the NCP Server's volume cache to be updated.

19.14 Activating and Deactivating an NSS Volume

After you set up and configure NSS volumes, you can activate and deactivate volumes to make them available to users and applications. To view details of a volume, it must be active.

1. In iManager, **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select one or more volumes that you want to make active or deactive.
4. Click **Activate** or **Deactivate**.

   After the page refreshes, you can see that each volume’s state matches the state you specified. If a selected volume is already in the specified state, no change occurs. The details of deactive volumes are not available.

19.15 Mounting and Dismounting an NSS Volume

After you set up and configure NSS volumes, you can mount and dismount volumes to make them available to users and APIs. After you mount a volume, it is only available to APIs until you activate it. Dismounting a volume makes it unavailable to users and to APIs.

- Section 19.15.1, “Dismounting an NSS Volume from the NCP Server,” on page 281
- Section 19.15.2, “Mounting or Dismounting an NSS Volume with iManager,” on page 281
- Section 19.15.3, “Mounting an Encrypted NSS Volume with NSSMU,” on page 282
- Section 19.15.4, “Dismounting an Encrypted NSS Volume with NSSMU,” on page 282

19.15.1 Dismounting an NSS Volume from the NCP Server

Before you can dismount an NSS volume, you must dismount the volume from NCP Server; otherwise, the dismount function fails.

1. At the server prompt, open the NCP Console by entering

   ```
   ncpcon
   ```
2. Dismount the volume from NCP.

   The volume is no longer accessible or visible to NCP clients.

19.15.2 Mounting or Dismounting an NSS Volume with iManager

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select one or more volumes that you want to mount or dismount.

4 Click **Mount** or **Dismount**.

After the page refreshes, you can see that the volume's state changed. If a selected volume is already in the specified state, no change occurs. The details of dismounted volumes are not available.

19.15.3 Mounting an Encrypted NSS Volume with NSSMU

You must mount an encrypted NSS volume from NSSMU on the first time it is started after a reboot in order to be able to supply the password. NSSMU allows you to mount only one volume at a time so that you can enter its password.

1 In NSSMU, select **Volumes**.
2 In the **Volumes** list, select the encrypted volume that you want to mount.
3 Press **F7** to mount the volume.
4 If you are prompted to enter the password, enter the password, then click **OK**.

You are prompted for the password on the first time the volume is mounted after a system reboot.

19.15.4 Dismounting an Encrypted NSS Volume with NSSMU

1 In NSSMU, select **Volumes**.
2 In the **Volumes** list, select the encrypted volume that you want to mount.
3 Press **F7** to dismount the mounted volume.

19.16 Exporting and Importing NSS Volumes for NFS Access

NSS volumes and their directories are NFSv3 exportable and accessible from remote systems. NFSv4 is not supported for NSS, but exports for other file systems using NFSv4 can coexist with NSS exports using NFSv3.

- Section 19.16.1, "Understanding NFS Export and Mount Options," on page 282
- Section 19.16.2, "Exporting NSS Volumes for NFSv3," on page 285
- Section 19.16.3, "Importing NSS Volumes," on page 287

19.16.1 Understanding NFS Export and Mount Options

- "Host Options" on page 282
- "Mount Options for Export via NFSv3" on page 283
- "Mount Options for Import via NFSv3" on page 284
- "Additional Information" on page 284

Host Options

The following table describes options for specifying which servers on the network can import the NFS volume. For more information, see the `exports(5)` man page.

Table 19-1 *Host Options for NFSv3 Export of NSS Volumes*

Mount Option	Description
Single host	Specify a single host by its fully qualified domain name or its IP address.
Netgroups	Specify NIS netgroups as *@groupname*, such as `@trusted`.
Wildcards	Specify a asterisk (*) to specify all hosts. Use the wildcard characters of asterisk (*) and question marks (?) in server names to match multiple servers. For example, `proj*.example.com` matches all hosts in the domain `example.com` that begin with `proj`.
IP networks	Specify all hosts on a network or subnetwork by specifying the IP address and netmask pair as *address/netmask*. For example: 10.10.10.1/ 255.255.252.0.

Mount Options for Export via NFSv3

Table 19-2 describes mount options available for mounting NSS volumes for export via NFSv3. For more information, see the `exports(5)` man page and the `mount(8)` man page.

Table 19-2 *Mount Options for NFSv3 Export of NSS Volumes*

Mount Option	Description
rw	Mount the NSS file system with Read/Write (`rw`) access.
no_root_squash	Disable `root` squashing for the superuser with the No Root Squash (`no_root_squash`) option. This allows `root` users on client computers to have `root` access on the server. With the No Root Squash option, mount requests for `root` are not mounted to the anonymous user (`nobody`). This option is needed for diskless clients. NSS volumes are logical volumes. They are not directly mounted on devices, but are associated with pools, which are mounted on devices. Because NSS volumes do not have a device directly associated with them, NFS treats the volume like a diskless client, which makes the `no_root_squash` option necessary when you mount NSS volumes.
sync	Specify the Sync (`sync`) option, which requires all file system writes to be committed to disk before the request can be completed.

Mount Option	Description
fsid=value	Importing with the `fsid` option works around the fact that there is no device associated with a logical volume. You must import the NSS volume or directory with the FSID option set on it for export: `fsid=`*n* Replace *n* with an integer value greater than 0. The numbers do not need to be sequential. For example, `fsid=1` and `fsid=10`. Make sure to use a unique `fsid` number for each NSS volume or directory you are exporting. **IMPORTANT:** FSID=0 is reserved for NFSv4 as the pseudo root of the exported file system for exported volumes on the Linux server.

Mount Options for Import via NFSv3

Table 19-3 describes mount options available for mounting NSS volumes for import via NFSv3. For more information, see the `mount(8)` man page.

Table 19-3 *Mount Options for NFSv3 Import of NSS Volumes*

Mount Option	Description
rw	Mount the NSS file system with Read/Write (`rw`) access.
sync	Specify the Sync (`sync`) option, which requires all file system writes to be committed to disk before the request can be completed.
noatime	NSS also supports the optional use of the `noatime` for importing and mounting NSS volumes by using NFS. The noatime option disables the updating of the access time for files so that reading a file does not update its inode access time (`atime`). For more information, see Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 465.

Additional Information

When you use NFS to export or import NSS volumes, other supporting services are needed, including DNS, NIS, and NFS. For information about configuring and managing these services, see the following links:

- “The Domain Name System” (https://www.suse.com/documentation/sles-12/book_sle_admin/data/cha_dns.html)
- “Using NIS” (https://www.suse.com/documentation/sles-12/book_security/data/cha_nis.html)
- “Sharing File Systems with NFS” (https://www.suse.com/documentation/sles-12/book_sle_admin/data/cha_nfs.html)

19.16.2 Exporting NSS Volumes for NFSv3

1 In a terminal console, log in as the `root` user.

2 In YaST, select **Network Services**, then select **NFS Server** to open the **NFS Server Configuration** page.

3 If NFS Server is not started and enabled, you must configure the NFS Server.

3a **NFS Server:** Select **Start**.

3b **Firewall:** Select **Open Port in Firewall** to allow access to the NFS service from remote computers, then click **Firewall Details** to specify the network interfaces where you want to open the port.

3c **Enable NFSv4:** Ensure that **Enable NFSv4** is not selected if you are exporting only via NFSv3.

IMPORTANT: NFSv4 is not supported for NSS, but exports for other file systems using NFSv4 can coexist with NSS exports using NFSv3. If you enable NFSv4, make sure that you enter the NSS directories for export with options that use non-zero settings for their FSIDs, and do not bind the NSS directories to paths in the pseudo-root file system that you set up for NFSv4 exports.

3d **Enable GSS Security:** To enable Kerberos secure access to the server, click **Enable GSS Security**. A prerequisite for this is to have Kerberos installed in your domain and both the server and the clients are kerberized.

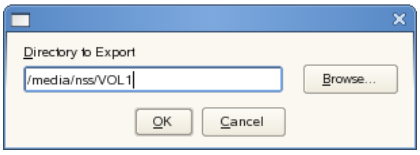
3e Click **Next** to continue to the **Directories to Export** page.

4 On the **Directories to Export** page, do the following for each NSS volume on the server that you want to export via NFSv3.

4a Under **Directories**, click **Add Directory**, to open a dialog box where you can configure the settings for a volume.

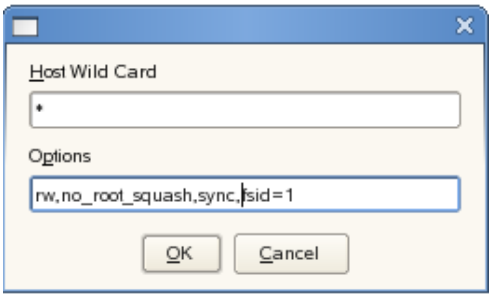
4b Specify the NSS volume that you want to export by typing the Linux path for the volume, or browse the Linux file system to locate and select the NSS volume, then click **OK**.

The default location of NSS volumes is `/media/nss/volumename`, such as `/media/nss/VOL1`.



4c In the Host Wildcard field, specify the servers where you want to be able to mount the NSS volume via NFSv3.

A default asterisk (*) wildcard indicates all servers. You can specify a single host, netgroups, wildcards, or IP networks. For information, see "Host Options" on page 282.



4d Enter the following required mount options:

`rw,no_root_squash,sync,fsid=`*value*

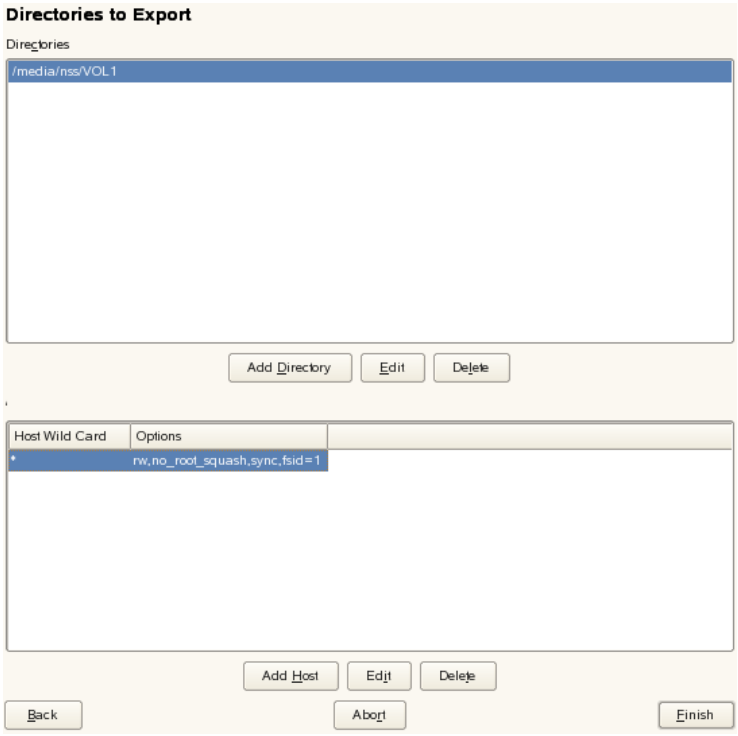
For NFSv3, make sure you do not include the fsid=0 or bind=`/pseudo_rootdir/volumename` options. Not using these options allows the export to be processed as an NSFv3 export.

For example:

`rw,no_root_squash,sync,fsid=1`

Separate the options with commands and no spaces. For information, see "Mount Options for Export via NFSv3" on page 283.

4e Click **OK** to save your settings and return to the **Directories to Export** page.



5 On the **Directories to Export** page, click **Finish** to apply the settings.

19.16.3 Importing NSS Volumes

1 On the OES server where you want to import the NSS volume via NFS, open YaST.

2 In YaST, select **Network Services**, then select **NFS Client** to open the **NFS Client Configuration** page.

3 Near the bottom of the page, select **Open Port in Firewall** to allow access to the NFS service from remote computers, then click **Firewall Details** to specify the network interfaces where you want to open the port

4 Do the following for each NSS volume on remote servers that you want to import via NFS.

4a Click **Add** to open a dialog box where you can specify the information for the volume you want to import.

4b In **NFS Server Hostname**, specify the remote server where the volume resides. Type the fully distinguished name (such as *servername.ou_context.o_context.com*), or click **Choose**, select the NFS server from a list of servers, then click **OK**.

4c In **Remote File System**, specify the path on the remote server where the volume resides. Type the full path such as `/media/nss/VOL1`, or click **Select** to open the Exported Directories dialog box, then select the path from the list of NFS exported directories on the selected server, then click **OK**.

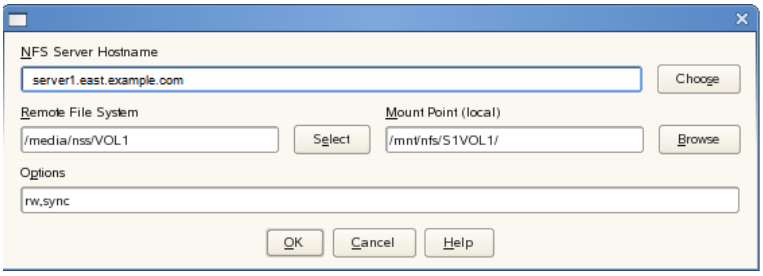
4d In **Mount Point (local)**, specify the path on the server (the NFS Client location) where you want to mount the remote volume, such as */mnt/nfs/volumename*, or click **Browse** to locate and select the location.

The **Browse** option allows you to create a new folder on the server for the target path.

4e Enter the following required mount options:

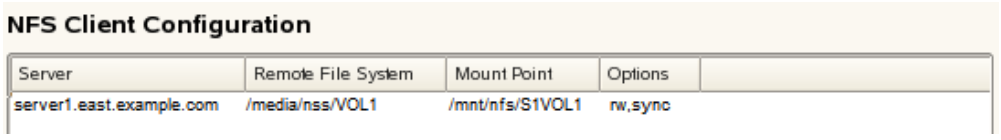
`rw,sync`

You can optionally specify the `noatime` option. For information, see Table 19-3 on page 284 and the `mount(8)` man page.



4f Click **OK** to save your settings and return to the **NFS Client Configuration** page.

The entry you just made should appear in the list.



4g When you are done adding volumes to be imported, continue with the next step.

5 On the **NFS Client Configuration** page, click **Finish** to apply the settings.

19.17 Deleting an NSS Volume

Deleting a volume removes the data in the volume and frees the space to be used by other volumes in the same pool. When you delete a volume, it is salvageable until one of the following events occurs:

- Volume Purge Delay times out. The deleted volume is purged automatically. For information, see Section 24.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 354.
- You manually purge the deleted volume. For information, see Section 24.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 357.

During the purge delay time, the deleted volume is salvageable, but the space belonging to the deleted volume is not available to other volumes and. When the purging process begins, the volume is no longer salvageable.

If it is necessary, you can restore a deleted volume before it is purged. See Section 24.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 357.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select one or more volumes that you want to delete.

   Wait for the page to refresh and make the **Delete** option available for the selected volume.
4. Click **Delete**.
5. Click **Yes** to confirm the deletion, or click **No** to cancel the deletion.

19.18 Finding the Filename for a Given ZID

You might get an error report that identifies the ZID for a file, but not the filename and path on the volume. To find the associated filename and full path for the file on a given volume and name space, use the /ZIDtoFilename option.

1. At the NSS Console (`nsscon`) prompt, enter the following command (all on the same line, of course):

   ```
   nss /ZIDtoFilename=ZIDnumber /ZIDNameSpace=namespace /
   ZIDVolumeName=volumename
   ```

   Replace *ZIDnumber* with the ZID of the file. Replace *namespace* with the Long, UNIX, Macintosh, or DOS name space to use for the search. Replace *volumename* with the name of the volume for the search.

19.19 Setting and Viewing the ZID Mode for a Volume

The `zidMode` allows NSS to decide whether the ZID for a given volume can go beyond the 32-bit limit (`0xffffffff`). When you set the ZID mode to `zid32`, and if the volume's ZID reaches the 32-bit limit, you can no longer create a file or folder in that volume because NSS does not serve a new ZID.

To view the ZID mode for a given volume, go to the file, `/_admin/Manage_NSS/Volume/<volumename>/VolumeInfo.xml` and search for `zidMode`. The options are: `zid32` or `zid64`.

Also, NSS provides an option to verify whether the volume is 64-bit ZID enabled or not. If the `nextAllocatableZid` for a given volume is greater than the 32-bit limit, it indicates that the volume is 64-bit ZID enabled. To verify, go to the file, `/_admin/Manage_NSS/Volume/<volumename>/VolumeInfo.xml` and search for `zid64Enabled`. The options are: `true` or `false`. If the `nextAllocatableZid` for a given volume is greater than `0xffffffff`, the value is set to `true`. Otherwise, it is set to `false`.

To configure ZID mode in both local and shared volumes:

- For local volumes, add `zid32` in the mount option for the volume in `/etc/fstab` to restrict the ZID from crossing 32-bit limit.

  For example:

  ```
  VOLNAME /media/nss/VOLNAME nssvol noauto,rw,name=VOLNAME,zid32 0 0
  ```

  Executing this command sets the ZID mode of a volume named VOLNAME to 32-bit ZID (`zid32`). After executing the command, you must unmount and mount the volume for the changes to take effect.
- For shared volumes, add `zid32` to the volume's `/opt` in the resource load script to restrict the ZID from crossing the 32-bit limit. The load script changes must be done using the iManager Cluster plug-in. For more information, see OES 2018 SP3: OES Cluster Services for Linux Administration Guide.

  For example: If CPOOL is a cluster pool with a volume CVOL, then to set the CVOL's ZID mode to 32-bit ZID, add the value to `/opt` in the pool cluster resource load script as follows:

  ```
  exit_on_err ncpcon mount /opt=ns=long,zid32 CVOL=volumeID
  ```

  After modifying the load script, you must take the pool cluster resource offline, then bring it online for the changes to take effect.

If the volume's mount option does not contain the ZID mode (`zidMode`) option, then NSS sets the default ZID mode as follows:

- For local volumes, the ZID mode is set to `zid64` by default in both the homogeneous and mixed-node cluster environment.
- For shared volumes, the ZID mode depends on the cluster node where the volume is available.
  - In a cluster environment, that is, nodes running on OES 2018 and later, the ZID mode is set to `zid64` by default.
  - In a mixed-node cluster environment, if any node is running on OES version earlier than OES 2018, the ZID mode is set to `zid32` by default.

However, when a shared volume with `zidMode` set to `zid32` is migrated to a node that is force enabled to 64-bit ZID using the `/ForceEnableZID64` command, then `zidMode` is set to `zid64` by default on the migrated node.

For example, consider a three node cluster environment, with node A (OES 2018), node B (OES 2015 SP1), and node C (OES 2018 SP1). By default, the ZID mode sets to `zid32` for a shared volume on node A. When a resource with the shared volume migrates to node B that is force enabled to 64-bit ZID using the `/ForceEnableZID64` command, the `zidMode` for that shared volume is set to `zid64` on the migrated node B.

You can still force enable the ZID mode to 64-bit ZID on a local or shared volume using the following command:

/ForceVolumeZid64Mode=<*volumename*>

This command is not persistent. When a server reboots, the setting returns to the default based on the environment where the volume is available. Even if you place the command in the `/etc/opt/novell/nss/nssstart.cfg` file, the command is not persistent.

19.20 Verifying or Rebuilding NSS Volumes

You cannot rebuild or verify an NSS volume independently of other volumes in the same pool. For guidelines and procedures for verifying and rebuilding NSS pools and volumes, see Chapter 17, “Verifying and Rebuilding NSS Pools and Volumes,” on page 233.

19.21 Moving Volumes with DFS

The Move Volume function uses OES Distributed File Services to move a volume’s file structure, data, and the file system trustee rights information from the original location to a new volume in the network. For guidelines and procedures for moving volumes, see “Using DFS to Move NSS Volumes” in the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.

19.22 Splitting Volumes with DFS

The Split Volume function uses OES Distributed File Services to move a specified part of a volume’s file structure, data, and the file system trustee rights information from the original location to a new volume in the network. A DFS junction replaces the selected directory and its contents in the source volume. The data and metadata in the directory are moved to the target location, which can be the root directory or other directory in the destination volume. For guidelines and procedures for splitting volumes, see “Using DFS to Split NSS Volumes” in the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.

19.23 What’s Next

For information about advanced volume features, see the following:

- “Managing Encrypted NSS Volumes” on page 293
- “Securing Access to NSS Volumes, Directories, and Files” on page 301

- “Managing Compression on NSS Volumes” on page 319
- “Managing Space Quotas for Volumes, Directories, and Users” on page 337
- “Salvaging and Purging Deleted Volumes, Directories, and Files” on page 351
- “Managing Hard Links” on page 363
- *OES 2018 SP3: Distributed File Services Administration Guide for Linux*
- *OES 2018 SP3: Dynamic Storage Technology Administration Guide*

20 Managing Encrypted NSS Volumes

OES Storage Services provides optional Encrypted Volume Support (EVS) for NSS volumes on OES 2 and later operating systems.

This section describes the following:

- Section 20.1, “Understanding Encrypted Volume Support,” on page 293
- Section 20.2, “Security Considerations for Encrypted Volumes,” on page 295
- Section 20.3, “Creating an Encrypted Volume,” on page 296
- Section 20.4, “Mounting an Encrypted NSS Volume with NSSMU,” on page 297
- Section 20.5, “Mounting Encrypted NSS Volumes with NSS Commands,” on page 297
- Section 20.6, “Dismounting an Encrypted NSS Volume with NSSMU,” on page 298
- Section 20.7, “Using Encrypted Volumes in a Server Cluster,” on page 298
- Section 20.8, “Removing Encrypted Volumes,” on page 299
- Section 20.9, “What’s Next,” on page 299

20.1 Understanding Encrypted Volume Support

NSS Encrypted Volume Support meets the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen. EVS is available only for newly created NSS volumes. EVS stores user data in encrypted format on the NSS volume, yet works transparently with most applications, NLM programs, and backup utilities that currently work with NSS.

Any NSS volume can be designated at volume creation time to be an encrypted volume. The Encrypted attribute stays with the volume throughout its life. An encrypted volume cannot later be converted to be unencrypted, nor can an unencrypted volume later be converted to be encrypted. This is a creation-time-only decision.

Dynamic Storage Technology (NSS) does not support using encrypted volumes in a DST shadow volume pair.

Encryption is transparent above the physical read/write layer of an NSS volume. It requires no changes for applications. All the rules of file system trustee assignments, trustee rights, ownership, sharing, visibility, locking, transactions, and space restrictions remain the same. Performance for an encrypted volume is slightly degraded compared to an unencrypted volume under the same conditions.

- Section 20.1.1, “Encryption Method,” on page 294
- Section 20.1.2, “Encryption Password,” on page 294
- Section 20.1.3, “How Encrypted Volume Support Works,” on page 294
- Section 20.1.4, “Guidelines for Using Encrypted Volumes,” on page 294

20.1.1 Encryption Method

Encrypted volume support uses the NICI libraries for all cryptographic support. NICI generates a 128 or 256-bit AES key for encryption that persists for the life of the volume. You cannot change the password because it is the key used to encrypt data. NICI uses the password to wrap the key and other volume-specific cryptographic information into a 128 or 256-bit package that is persistently stored in two locations on the NSS media: the Volume Data Block and the Volume Locator storage object. After the cryptographic data is wrapped for the activated volume, EVS eliminates the password from memory.

Before OES 2018 SP2, NSS supported only the AES-128 encryption algorithm while creating encrypted volumes. Beginning with OES 2018 SP2, NSS supports both AES 128 and 256-bit encryption algorithm. As AES-256 encryption has a larger key size, it offers a high level of security compared to AES-128. Using AES with 256-bit key size enhances the number of AES rounds that need to be done for each data block, such as it takes 10 rounds for 128-bit and 14 rounds for 256-bit encryption. It adds an extra layer of security for users, and the password will be safe with 256-bit encryption.

20.1.2 Encryption Password

The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128 or 256-bit NICI key for encryption. The password is set when you create the volume. It persists for the life of the volume; it cannot be changed later.

20.1.3 How Encrypted Volume Support Works

On the first activation after a system reboot, you must enter a valid password. When the volume is activated, NSS loads the volume's persistent data from the Volume Data Block. If the Encrypted attribute is enabled for a volume, NSS searches in memory for a known key in the list of volume names and keys. If the key is present, it is used. If no key is present, NSS consults the list of volumes and passwords. If a password is available, it is used to unwrap the key from the persistent data and the new key is placed in the list of volumes and keys. The password is eliminated from memory.

After the encrypted volume is activated, all encryption operations on user data are transparent to file system applications that use normal file I/O functions. Data written to files is held in cache until the time it would be normally written. At physical write time, the data is encrypted to a temporary write buffer and written to the volume in encrypted format.

During reads, the cache is consulted, as it would normally be, to determine if a requested block is already in memory. If the requested data block is in cache, the clear-text data is transferred. If it is not, a physical read request is made, with the read directed to a temporary buffer. After read completion, but before control is returned to the calling program, the encrypted data in the temporary buffer is decrypted into a cache buffer. The read proceeds normally, with clear-text data being made available to all future requestors.

20.1.4 Guidelines for Using Encrypted Volumes

- We recommend that you avoid mixing encryption and compression features in a volume. Use one or the other, but not both.
- You can enable the Encryption attribute only at volume creation time.

- If it is enabled, the Encrypted volume attribute persists for the life of the volume.
- To encrypt an existing volume, you must create a new encrypted volume, then migrate existing data from the unencrypted volume to the encrypted volume.
- The encryption password is 6 to 16 standard ASCII characters.

20.2 Security Considerations for Encrypted Volumes

- Section 20.2.1, “Choosing a Strong Encryption Password,” on page 295
- Section 20.2.2, “Backing Up Data from an Encrypted Volume,” on page 295
- Section 20.2.3, “Excluding the NSS Cache Memory from Core Dumps,” on page 295
- Section 20.2.4, “Disabling Logs,” on page 295
- Section 20.2.5, “Using Direct I/O to an Encrypted Volume,” on page 296
- Section 20.2.6, “Sharing Encrypted NSS Volumes in a Cluster,” on page 296

20.2.1 Choosing a Strong Encryption Password

The encryption password is 6 to 16 standard ASCII characters. Make sure to employ security best practices for passwords. For information, see Section 31.15, “Creating Strong Passwords,” on page 437.

20.2.2 Backing Up Data from an Encrypted Volume

Make sure to encrypt the data from an encrypted volume on backup media. Backups of an encrypted volume are not encrypted, unless it is a feature of the backup software you use. For information, see Section 31.4, “Protecting Data During Backup and on Backup Media,” on page 430.

20.2.3 Excluding the NSS Cache Memory from Core Dumps

Make sure that you exclude the NSS cache memory from core dumps; otherwise, encrypted NSS volume data might be displayed in the clear. For information, see Section 31.5, “Preventing Exposure of Sensitive Data in a Core Dump,” on page 430.

20.2.4 Disabling Logs

When working with encrypted volumes, it is important to realize that the volume password and key information is exchanged between user and kernel space as encrypted volumes are created and/or mounted. If you have logging enabled on the Linux server when you enter the encryption password, your password and volume key information might show up in the log file.

Even though the logging mechanisms are `root` user protected, we strongly recommend that you make sure logging is disabled when creating an encrypted volume or mounting the encrypted volume after a system reboot in order to protect the secrecy of your password credentials at these critical times when you are entering the encryption password.

For information, see Section 31.6, “Preventing Exposure of the Encryption Password in a Log,” on page 431.

20.2.5 Using Direct I/O to an Encrypted Volume

Direct I/O to an encrypted volume bypasses the EVS encryption engine and allows data to be stored in unencrypted format on the encrypted volume. This capability is useful for diagnostic, repair, or special-purpose applications, but should be avoided otherwise.

You should avoid using direct-I/O applications on encrypted volumes, especially for user data that you intend to be stored in encrypted format.

20.2.6 Sharing Encrypted NSS Volumes in a Cluster

When you mount the shared volume and enter the password, NSS uses the password to create a key, which it stores in the server memory. The OES Cluster Services software passes the key to other nodes. After all servers hold the key, the volume is available while any one of the servers is still participating actively in the cluster. If all servers in the cluster fail, you must repeat this procedure when you recover the cluster and restart services.

20.3 Creating an Encrypted Volume

NSS Encrypted Volume Support allows you to create encrypted NSS volumes using NSSMU version 3.20 build 940 or later. You can create encrypted user data volumes only after the installation or upgrade process.

If you choose to encrypt a volume, you cannot roll back the system to earlier versions of OES 2 without taking steps to preserve your data before the rollback. For information, see Section 20.8, “Removing Encrypted Volumes,” on page 299.

WARNING: We strongly recommend that you verify that your system is working as desired before creating encrypted volumes on the system.

---

1. In NSSMU, select **Volumes**, then press **Enter**.
2. To create a new volume, press the **Insert** key.

   A query asks if you want to encrypt the volume.
3. To encrypt the new volume, select **Yes**, then press **Enter**.

   NSS enables the Encrypted attribute for the volume, then prompts you to select the encryption key type for the volume.
4. Select the encryption key type and enter a password, then enter password again to verify it.

   The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128 or 256-bit NICI key for encryption. The password persists for the life of the volume; it cannot be changed later.
5. Set the volume size and other attributes, as desired.

   When you are done, the encrypted volume is active and mounted.

You must supply the encryption password for the volume on the first volume mount after a system boot or reboot. For information, see Section 20.4, “Mounting an Encrypted NSS Volume with NSSMU,” on page 297.

For information about entering the password for a volume in a cluster, see Section 20.7, “Using Encrypted Volumes in a Server Cluster,” on page 298.

20.4 Mounting an Encrypted NSS Volume with NSSMU

Mount only one volume at a time so that you can enter its password.

IMPORTANT: For encrypted NSS volumes, you can mount the volume only from NSSMU the first time it is mounted after a reboot.

---

1. In NSSMU, select **Volumes**.
2. In the **Volumes** list, select the encrypted volume that you want to mount.
3. Press **F7** to mount the volume.
4. If you are prompted to enter the password, enter the password, then click **OK**.

   You are prompted for the password on the first time the volume is mounted after a system reboot. The password is stored on the system until the next system reboot. You can mount the volume without the password until a system reboot occurs.

20.5 Mounting Encrypted NSS Volumes with NSS Commands

You must enter a password only on the first activation following a system reboot. Thereafter, other environmental security and authentication measures control access to user data.

IMPORTANT: The NSS Console (`nsscon`) does not support entering the password from the command line. You must mount the encrypted volume from NSSMU on the first time after a system reboot. Thereafter, you can use the commands in this section without supplying the password. For information, see Section 20.4, “Mounting an Encrypted NSS Volume with NSSMU,” on page 297.

Syntax

The following table provides the syntax for NSS commands to use with encrypted volumes on subsequent mounts of the volume until the system reboots. Enter the commands from nsscon. In each case, replace *volname* with the name of the encrypted NSS volume.

You cannot use the wildcard option of `all` as the *`volname`* before an encrypted volume is mounted with its password following each system reboot. The All option does not find the volume and does not execute the command.

Table 20-1 *Volume Mount Commands*

Command	Description
`mount volname`	Mounts an encrypted or unencrypted NSS volume. The `mount` command is usable for encrypted volumes only after a previous activation with password. Otherwise, it returns an error message, requesting more information.
`mount all`	Activates and mounts all encrypted NSS volumes that have been previously activated with their passwords. Encrypted NSS volumes that were not previously activated are not mounted. Mount them from NSSMU, where you can provide the encryption password.
`nss /volumes`	Displays a list of encrypted and unencrypted NSS volumes, showing their attributes. The encrypted volume returns a status of Encrypted.

20.6 Dismounting an Encrypted NSS Volume with NSSMU

Before you can dismount an NSS volume, you must dismount the volume from NCP Server; otherwise, the dismount function fails.

1. If NCP Server is running, dismount the volume from NCP Server.
   - **1a** At the server prompt, open the NCP Console by entering

     ```
     ncpcon
     ```

   - **1b** Dismount the volume from NCP.

     The volume is no longer accessible or visible to NCP clients.
2. Dismount the volume.
   - **2a** From a terminal console, start NSSMU, then select **Volumes**.
   - **2b** In the **Volumes** list, select the encrypted volume that you want to dismount.
   - **2c** Press **F7** to dismount the mounted volume.

20.7 Using Encrypted Volumes in a Server Cluster

If you use an encrypted NSS volume in a OES Cluster Services cluster, you must manually enter the password for the volume on one of the servers only when you first start or restart the cluster. You use NSSMU to mount the encrypted volume on one of the OES servers and enter the volume password, then dismount volume before you can bring the cluster resource online for the first time.

NSS uses the password to create a key, which it stores in the server memory. The OES Cluster Services software passes the key to other nodes. After all servers hold the key, the volume is available while any one of the servers is still participating actively in the cluster. If all servers in the cluster fail, you must repeat this procedure when you recover the cluster and restart services.

1. Boot or restart the servers in the cluster.

If you automated the loading of cluster resources, the cluster reports that each resource is comatose because it cannot bring the corresponding encrypted volume online.

If you opt to manually start cluster resources, the cluster resources are not yet active.

2 From one of the nodes in the cluster, repeat the following steps for each of the encrypted volumes in the cluster.

2a In NSSMU, select **Volumes**.

2b In the **Volumes** list, select the shared volume you want to mount.

2c Press **F7** to mount the shared volume.

2d When prompted, enter the password, then click **OK**.

If the server already knows the key for the volume, you are not prompted for the password.

2e In the **Volumes** list, select the shared volume that you want to dismount.

2f Press **F7** to dismount the shared volume.

3 Follow the normal procedures to activate the cluster resources.

For information, see the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*. The node passes the key information to the other nodes. While at least one of the servers is actively participating in the cluster, you do not need to reenter the encryption password again.

20.8 Removing Encrypted Volumes

If a rollback becomes necessary, you must remove the encrypted volume from the server before you perform the rollback.

Encrypted volumes require OES 2 Linux or later. Because earlier releases of NSS cannot activate an encrypted volume, you cannot roll back the system to the earlier release. If you do, the encrypted volume fails to activate or mount, and its pool cannot be repaired.

To prevent this potential data loss, make sure that the system upgrade to a supported platform is active and performing as desired before creating encrypted volumes.

1 Create an unencrypted volume where you want to copy the data.

For information, see Section 20.3, “Creating an Encrypted Volume,” on page 296.

2 Use one of these methods to save the encrypted volume’s data on the unencrypted volume:

- Back up the volume’s data in unencrypted format on backup media, then restore the data to the unencrypted volume.
- Make a volume-to-volume copy of the data from the encrypted volume to the unencrypted volume.

3 Delete the encrypted volume.

4 Perform the system rollback.

20.9 What’s Next

Manage other NSS features of your encrypted volume as you would for an unencrypted volume. For information, see “Managing NSS Volumes” on page 261.

21 Securing Access to NSS Volumes, Directories, and Files

This section describes measures you can use to help secure access to your OES Storage Services (NSS) volumes and user data.

- Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301
- Section 21.2, “Configuring the Security Equivalence Vector Update Frequency,” on page 309
- Section 21.3, “Using Data Shredding to Prevent Access to Purged Files,” on page 312
- Section 21.4, “Enabling or Disabling LAF Audit Log Messages for Trustee Events,” on page 313

21.1 Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes

NSS uses the OES Trustee model for controlling access to user data. As an administrator or a user with the Supervisor right or Access Control right, you can use the Files and Folders plug-in to iManager to manage file system trustees, trustee rights, inherited rights filters, and attributes for a file or folder on an NSS volume. A user who has only the Access Control right cannot modify the Supervisor right of another user. To manage AD users, use the supported NSS command line utilities or NFARM.

IMPORTANT: For more information and alternate methods for configuring file system trustees and attributes for directories and files on NSS volumes, see the *OES 2018: File Systems Management Guide*.

- Section 21.1.1, “Prerequisites for Configuring Trustees,” on page 301
- Section 21.1.2, “Viewing Properties of a File or Folder,” on page 302
- Section 21.1.3, “Configuring File or Folder Attributes,” on page 303
- Section 21.1.4, “Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter),” on page 304
- Section 21.1.5, “Viewing Effective Rights for a Trustee,” on page 307
- Section 21.1.6, “Managing Rights,” on page 308

21.1.1 Prerequisites for Configuring Trustees

- The volume that you want to manage must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the volume, folder, and file that you want to manage.

- The volume must be a file system that uses the OES trustee model for file access, such as an NSS volume on OES 2015 or later, an NSS or NetWare traditional volume on NetWare 6.5, or an NCP (NetWare Core Protocol) volume (an NCP share on a Linux POSIX file system) on OES 2015 or later.
- NSS does not support dynamic and nested eDirectory groups. Although it is possible to add these groups as trustees in NSS volumes, NSS does not recognize the rights assigned to them as applying to group members.

21.1.2 Viewing Properties of a File or Folder

1 In iManager, click **Files and Folders > Properties** to open the **Properties** page.

2 Click the **Search** icon to browse and locate volume, folder or file from the Storage objects, then click the name link of the object to select it.

The pathname of the object appears in the **Name** field.

3 View the following properties in three **Properties** tabs:

Properties Tabs	Description	For Information
Information	• View details about the selected volume, folder, or file. • Configure directory quotas for folders on NSS volumes where the Directory Quotas attribute is enabled. • Modify the file owner. • Configure file or directory attributes.	See Section 26.7, "Viewing or Modifying File or Folder Properties," on page 380. See Section 26.9, "Viewing, Adding, Modifying, or Removing a Directory Quota," on page 386. See Section 26.8, "Viewing or Modifying File Ownership," on page 384. See Section 21.1.3, "Configuring File or Folder Attributes," on page 303.
Rights	• View details about trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file. • Add or remove trustees. • Grant or revoke trustee rights for one or more trustees. • Configure the inherited rights filter.	See Section 21.1.4, "Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter)," on page 304.
Inherited Rights	• View details about explicitly assigned trustee rights and inherited rights at all levels along the path from the selected file or folder to the `root` of the volume. • View the effective rights for a given trustee for the selected volume, folder, or file.	See Section 21.1.5, "Viewing Effective Rights for a Trustee," on page 307.

21.1.3 Configuring File or Folder Attributes

File attributes determine how the file or folder behaves when accessed by any user. File attributes apply universally to all users. For example, a file that has a read-only attribute is read-only for all users.

Attributes can be set by any trustee with the Modify right to the directory or file, and attributes stay set until they are changed. Attributes do not change when you log out or when you down a file server.

For example, if a trustee with the Modify right enables the Delete Inhibit attribute for a file, no one, including the owner of the file or the network administrator, can delete the file. However, any trustee with the Modify right can disable the Delete Inhibit attribute to allow the file's deletion.

1. In iManager, click **Files and Folders > Properties** to open the **Properties** page.
2. Click the **Search** icon to browse and locate volume, folder or file from the Storage objects, then click the name link of the object to select it.

   The pathname of the object appears in the **Name** field. For example:

   ```
   VOL1:dir1\dirB\filename.ext
   ```
3. Click the **Information** tab to view or modify the file or folder attributes. Enable or disable an attribute by selecting or deselecting the check box next to it.

   IMPORTANT: Changes do not take effect until you click **OK** or **Apply**. If you click a different tab before you save, changes you make on this page are lost.

The following table defines file system attributes and whether they apply to files, folders, or both files and folders.

Attribute	Description	Files	Folders
Read Only	Prevents a file from being modified. This attribute is typically used in combination with Delete Inhibit and Rename Inhibit.	Yes	No
Archive	Identifies files and folders that have been modified since the last backup. This attribute is assigned automatically.	Yes	Yes
Hidden	Hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
Shareable	Allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No
Purge Immediate	Flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered.	Yes	Yes
Rename Inhibit	Prevents the directory or filename from being modified.	Yes	Yes
Delete Inhibit	Prevents users from deleting a directory or file. This attribute overrides the file system trustee Erase right. When Delete Inhibit is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this attribute to allow the directory or file to be deleted. **NOTE:** Setting the following preferences override the delete inhibit and rename inhibit settings. The override option is made available via volume mount options and nsscon. ◆ From nsscon enter, `/(No)RootOverrideFA=(ALL|VOL1,VOL2)` ◆ For local volumes change the following: `/etc/fstab (-o name=<NAME>,overrideFA)` ◆ For shared volumes change the following: cluster resource load scripts (`/opt=overrideFA`) If `/RootOverrideFA` is set on the volume, the Linux `root` user can delete and rename a file.	Yes	Yes

4 If you modified any settings, click **Apply** or **OK** to save your changes.

21.1.4 Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter)

File system trustees, trustee rights, and inherited rights filters are used to determine access and usage for directories and files on NSS volumes on OES 2015 or later, NCP volumes on OES 2015 or later, and NSS and NetWare Traditional volumes on NetWare 6.5. If you modify any settings, you must click **Apply** or **OK** to save the changes.

Viewing, Adding, or Removing File System Trustees

A trustee is any NetIQ eDirectory object (such as a User object, Group object, Organizational Role object, or other container object) that you grant one or more rights for a directory or file. Trustee assignments allow you to set permissions for and monitor user access to data.

1. In iManager, click **Files and Folders**, then click **Properties** to open the **Properties** page.
2. On the **Properties** page, select a volume, folder, or file to manage.

   For instructions, see Section 21.1.2, "Viewing Properties of a File or Folder," on page 302.
3. Click the **Rights** tab to view the trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file.
4. Add trustees.
   - **4a** Scroll down to the **Add Trustees** field.
   - **4b** Use one of the following methods to add usernames as trustees:
     - Click the **Search** icon, browse to locate the usernames of the users, groups, or roles that you want to add as trustees, click the name link of the objects to add them to the **Selected Objects** list, then click **OK**.
     - Click the **History** icon to select usernames from a list of users, groups, or roles that you recently accessed.
     - Type the typeless distinguished username (such as username.context) in the **Add Trustees** field, then click the **Add** (+) icon.

     The usernames appear in the Trustees list, but they are not actually added until you click **Apply** or **OK**. Each of the usernames has the default Read and File Scan trustee rights assigned.
   - **4c** On the **Properties** page, click **Apply** to save the changes.
5. Remove trustees.
   - **5a** Scroll down to locate and select the username of the user, group, or role that you want to remove as a trustee.
   - **5b** Click the **Remove** (red X) icon next to the username to remove it as a trustee.

     The username disappears from the list, but it is not actually removed until you click **Apply** or **OK**.
   - **5c** On the **Properties** page, click **Apply** to save changes.

Viewing, Granting, or Revoking File System Trustee Rights

Administrator users and users with the Supervisor right or the Access Control right can grant or revoke file system trustee rights for a volume, folder, or file. Only the administrator user or user with the Supervisor right can grant or revoke the Access Control right.

1. In iManager, click **Files and Folders**, then click **Properties** to open the **Properties** page.
2. On the **Properties** page, select a volume, folder, or file to manage.

   For instructions, see Section 21.1.2, "Viewing Properties of a File or Folder," on page 302.
3. Click the **Rights** tab to view the trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file.

4 Scroll to locate the username of the trustee you want to manage.

5 In the check boxes next to the trustee name, select or deselect the rights you want to grant or revoke for the trustee.

IMPORTANT: Changes do not take effect until you click **OK** or **Apply**. If you click a different tab before you save, any changes you have made on this page are lost.

Trustee Right	Description
Supervisor (S)	Grants the trustee all rights to the directory or file and any subordinate items. The Supervisor right cannot be blocked with an inherited rights filter (IRF) and cannot be revoked. Users who have this right can also grant other users any rights to the directory or file and can change its inherited rights filter. Default=Off
Read (R)	Grants the trustee the ability to open and read files, and open, read, and execute applications. Default=On
Write (W)	Grants the trustee the ability to open and modify (write to) an existing file. Default=Off
Erase (E)	Grants the trustee the ability to delete directories and files. Default=Off
Create (C)	Grants the trustee the ability to create directories and files and salvage deleted files. Default=Off
Modify (M)	Grants the trustee the ability to rename directories and files, and change file attributes. Does not allow the user to modify the contents of the file. Default=Off
File Scan (F)	Grants the trustee the ability to view directory and filenames in the file system structure, including the directory structure from that file to the root directory. Default=On
Access Control (A)	Grants the trustee the ability to add and remove trustees for directories and files and modify their trustee assignments and inherited rights filters. This right does not allow the trustee to add or remove the Supervisor right for any user. Also, it does not allow to remove the trustee with the Supervisor right. Default=Off

6 Click **Apply** or **OK** to save changes.

NOTE: The DFS junctions rights modification is not supported. This will be disabled. Use DFS tasks for junction rights management.

Configuring the Inherited Rights Filter for a File or Directory

File system trustee rights assignments made at a given directory level flow down to lower levels until they are either changed or masked out. This is referred to as inheritance. The mechanism provided for preventing inheritance is called the inherited rights filter. Only those rights allowed by the filter are inherited by the child object. The effective rights that are granted to a trustee are a combination of explicit rights set on the file or folder and the inherited rights. Inherited rights are overridden by rights that are assigned explicitly for the trustee on a given file or folder.

1. In iManager, click **Files and Folders**, then click **Properties** to open the **Properties** page.
2. On the **Properties** page, select a volume, folder, or file to manage.

   For instructions, see Section 21.1.2, “Viewing Properties of a File or Folder,” on page 302.
3. Click **Information**, then scroll down to view the inherited rights filter.

   The selected rights are allowed to be inherited from parent directories. The deselected rights are disallowed to be inherited.
4. In the **Inherited Rights Filter**, enable or disable a right to be inherited from its parent directory by selecting or deselecting the check box next to it.
5. Click **Apply** or **OK** to save the changes.

21.1.5 Viewing Effective Rights for a Trustee

Effective rights are the explicit rights defined for the trustee plus the rights that are inherited from the parent directory. The **Inherited Rights** page shows the inheritance path for a trustee for the selected file or folder and the effective rights at each level from the current file or directory to the root of the volume. You can use this information to help identify at which directory in the path a particular right was filtered, granted, or revoked.

1. In iManager, click **Files and Folders**, then click **Properties** to open the **Properties** page.
2. On the **Properties** page, select a volume, folder, or file to manage.

   For instructions, see Section 21.1.2, “Viewing Properties of a File or Folder,” on page 302.
3. On the **Properties** page, click the **Inherited Rights** tab to view the effective rights for a given trustee.

   By default, the page initially displays the effective rights for the username you used to log in to iManager.
4. On the **Inherited Rights** page, click the **Search** icon next to the **Trustee** field to browse for and locate the username of the trustee you want to manage, then select the username by clicking the name link.

   The path for the selected file or folder is traced backwards to the root of the volume. At each level, you can see the rights that have been granted and inherited to create the effective rights for the trustee.
5. If you make any changes, click **Apply** or **OK** to save them.

21.1.6 Managing Rights

Users can receive rights in a number of ways, such as explicit trustee assignments, inheritance, and security equivalence. Rights can also be limited by Inherited Rights Filters and changed or revoked by lower trustee assignments. The net results of all these actions—the rights a user can employ—are called effective rights.

- "Viewing or Modifying the Effective Rights of a Trustee" on page 308
- "Assigning or Modifying Rights to Files and Folders" on page 308
- "Limitations in Effective Rights, and Rights to Files and Folders" on page 309

Viewing or Modifying the Effective Rights of a Trustee

View the effective rights for a trustee. If needed, you can modify the trustee's rights on a file, folder or volume.

NOTE: Ensure to LUM-enable the non-default admin users for viewing effective rights.

Effective Rights details include the following:

Server: Displays the name of the server where the volume, folder or file exists along with the trustee information.

Location: Displays the location of the volume, file or folder.

Trustees: Lists the trustees who have effective rights on the file, folder or volume listed in Location.

To view or modify the rights for a particular trustee which will be reflected in the effective rights:

1. In iManager, click **Files and Folders > Properties** to open the Properties page.
2. Click the (Object Selector) icon to browse the storage objects, locate and select the name link of the file or folder you want to manage, then click **OK** to view the Properties for the file. For more instructions, see Section 21.1.2, "Viewing Properties of a File or Folder," on page 302.
3. Click the **Effective Rights** tab to view the list of trustees and their effective rights on the chosen folder or file.
4. To modify the rights for a particular trustee which will be reflected in the effective rights, click the hyper-linked name of a trustee.
5. On the Rights to Files and Folder page, modify the rights and click **Apply**.

Assigning or Modifying Rights to Files and Folders

Use this feature to assign or modify the rights that a trustee has on a folder or file.

Rights to Files and Folders details include the following and they are displayed based on the context from where this page is invoked:

Modify User / Modify Group: Displays the name of the trustee for whom the rights are being assigned or modified.

Volume: Displays the selected volume. It's a read-only field.

Files and Folders: Lists the files and folders for which you can modify the rights for the trustee displayed in Rights to Files and Folders.

To modify or add rights on a file or folder for a trustee:

1. In iManager, click **Users > Modify User** or **Groups > Modify Group** to open the Modify User page.
2. Under Volume, using the search (Search) button, select the volume where the file or folder exists. You can also choose a recently used volume using the (History) button.
3. Under File and Folders Trustee Rights, click **Add** to select file(s) or folder(s) and the selected entities get listed under Files/Folders section.
4. Under Files and Folders section, for a file or folder, modify or assign rights and then click **Apply**. Use the (Delete) button, to delete an entity under Files and Folders.

TIP

- Use collapse or expand buttons to collapse or expand the list of files and folders.
- Use the Filter option to search for a file or folder from the displayed list. Nested filter is supported. For example, if you specify the search string as "ark dir", the files and folders will be filtered based on "ark" string first, and then a sub-search is done for "dir" on the filter result of "ark".
- Use the (unsorted), (sorted ascending), and (sorted descending) buttons to sort the list of files and folders.

Limitations in Effective Rights, and Rights to Files and Folders

- Viewing Effective Rights on non-NSS (NCP) Volumes not supported.
- Viewing the soft-linked files or folders in a volume using the Properties under Files and Folders is not supported.
- You will see the primary file too when the rights are modified for the hard linked files.
- The Effective rights is not supported for DST Shadow Volume files in this release.

21.2 Configuring the Security Equivalence Vector Update Frequency

The Security Equivalence Vector (SEV) is used to validate the user against the trustee rights of the directory and file the user is attempting to access. You can use commands in the NSS Console utility (`nsscon`) to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors.

- Section 21.2.1, “Understanding the SEV,” on page 310
- Section 21.2.2, “Enabling or Disabling the Background SEV Update,” on page 310
- Section 21.2.3, “Configuring the Background SEV Update Interval,” on page 311
- Section 21.2.4, “Forcing a Background SEV Update,” on page 311

21.2.1 Understanding the SEV

The Security Equivalence Vector (SEV) is calculated for each NSS user based on information in the user's profile in NetIQ eDirectory. It is a list of eDirectory GUIDs, for example:

- the user's own GUIDs
- GUIDs of groups that include the user
- GUIDs of parent containers for the user and his or her groups
- security equivalent GUIDs

After you boot the Linux server, when a user first attempts to connect to the NSS file system, NSS contacts NetIQ eDirectory to retrieve the user's Security Equivalence Vector (SEV). eDirectory calculates the user's effective rights for the NSS volume, creates the SEV, and passes it to NSS. NSS compares the user's SEV with file system trustees and trustee rights for the specified file or directory to determine if the user can access the resource.

For NetWare, whenever a user connects to the NSS file system, NetWare retrieves the user's SEV from eDirectory and maintains it as part of the connection structure for the user's session. NSS automatically retrieves the user's SEV from the NetWare connection structure, then deletes it when the session ends.

The SEV behavior differs from the NetWare behavior because NSS does not have the same integrated relationship to the connection infrastructure as it does on NetWare. NSS caches the SEV locally in the server memory, where it remains until the server is rebooted or the user is deleted from eDirectory. NSS polls eDirectory at a specified interval for updates to the SEVs that are in cache.

21.2.2 Enabling or Disabling the Background SEV Update

By default, the SEV is updated in the background and whenever the server is rebooted. You can optionally disable the background updating. If it is disabled, the user access can become unsynchronized over time, so that users might have less or more access than you have configured. We recommend that you leave the SEV updating feature enabled, then modify the polling frequency to best meet the security needs of your production environment.

To enable or disable the setting:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, do one of the following:
   - **Enable:** This is the default. To enable the background updating of the SEV in addition to the default update at server reboot, enter

     ```
     nss /SecurityEquivalenceUpdating
     ```

   - **Disable:** To disable the background updating, enter

     ```
     nss /NoSecurityEquivalenceUpdating
     ```

The SEV Update is enabled when you first reboot the server. If you disable SEV updates and want the setting to persist across server reboots, include the `/SecurityEquivalenceUpdating` option in the `/etc/opt/novell/nss/nssstart.cfg` file.

21.2.3 Configuring the Background SEV Update Interval

You might want to modify the background SEV update interval to make the polling for eDirectory updates to be more or less frequent. Polling too frequently can impact performance. Polling too infrequently can cause delays in granting or restricting access for certain users. To avoid possible security violations, you can also force an update at any time by using the /ForceSecurityEquivalenceUpdate command. For information, see Section 21.2.4, "Forcing a Background SEV Update," on page 311.

The interval for the background updating of the SEV is the elapsed time between the last update and the next one. At the end of the elapsed time, NSS requires updated SEVs from eDirectory and Active Directory (if configured). The default interval is 7200 seconds (2 hours). The valid range is 300 (5 minutes) to 7776000 (90 days).

To set the interval to use until the next server reboot:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   nss /UpdateSecurityEquivalenceInterval=value
   ```

   Replace *value* with the desired interval.

To make the interval setting persistent across server reboots, include the `/UpdateSecurityEquivalenceInterval=value` option in the `/etc/opt/novell/nss/nssstart.cfg` file.

21.2.4 Forcing a Background SEV Update

If you modify user's access control settings or remove a user from eDirectory in between SEV update intervals, you can to force the SEV to be updated immediately after that to avoid possible security violations. Use the `/ForceSecurityEquivalenceUpdate` option to force an immediate update for all users in the NSS file system so that your changes can be reflected immediately in the user's active SEV for this server.

To force an immediate update:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   nss /ForceSecurityEquivalenceUpdate
   ```

21.3 Using Data Shredding to Prevent Access to Purged Files

Data shredding hides purged files by overwriting them with random patterns of hexadecimal characters. This prevents unauthorized users from using a disk editor to access purged files.

If the Data Shredding attribute for an NSS volume is disabled, unauthorized access to data is possible. An individual can extend a file, LSEEK to the end of the existing file data, and then read the data. This returns the decrypted leftover data that is in the block.

You can place up to seven data shred patterns over deleted data. Data shredding truly erases files. Only files that have been purged are shredded. If Salvage is enabled, there remains a purge delay between when the file is deleted and purged during which users can still salvage deleted files.

Data shredding consumes a great deal of disk connection bandwidth, resulting in a performance penalty for using the disk and system resources needed to overwrite the shredded file. Unless you must use data shredding for security reasons, the Data Shredding attribute for your NSS volume can be disabled or set to a lower number of shredding passes.

This section describes the following:

- Section 21.3.1, “Setting the Data Shredding Attribute When You Create a Volume,” on page 312
- Section 21.3.2, “Setting the Data Shredding Attribute for an Existing Volume,” on page 312
- Section 21.3.3, “Disabling Data Shredding for an Existing Volume,” on page 313

21.3.1 Setting the Data Shredding Attribute When You Create a Volume

When you create a volume, simply select the **Data Shredding** check box and specify the number of shredding cycles with an integer number between 1 and 7 times (or specify 0 to indicate no shredding capability) when you set the volume’s attributes. For more information, see Section 19.3, “Creating Unencrypted NSS Volumes,” on page 268.

21.3.2 Setting the Data Shredding Attribute for an Existing Volume

1. In iManager, click **Storage > Volumes** to open the Volumes page.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

   Wait until the page refreshes with a list of volumes in the **Volumes** list.
3. From the **Volumes** list, select the volume that you want to manage.
4. Click **Properties > Attributes**.

   This opens the **Volume Properties** page to the **Attributes** tab.
5. Select the **Data Shredding** check box.
6. Specify the number of shredding cycles, where 0 is no shredding and 1 to 7 are the valid number of cycles to shred data.

7 Click **Apply** or **OK** to save the change, or click **Cancel** to back out of the process.

If you click **Apply**, iManager saves the change and remains on the device page. If you click **OK**, iManager saves the change and takes you to the main Storage page. If you do not click **Apply** or **OK**, the setting is not implemented.

21.3.3 Disabling Data Shredding for an Existing Volume

WARNING: If you disable data shredding, an individual can recover leftover data on the drive and secure data might be exposed.

1 At the NSS console (nsscon), enter

`nss /nodatashredding=`*`volumename`*

where *volumename* is the name of the volume where you want to prevent the shredding capability.

21.4 Enabling or Disabling LAF Audit Log Messages for Trustee Events

Use the NSS audit log messages commands to enable or disable messages via Lightweight Auditing Format (LAF) for NSS trustee changes for NSS volumes on OES 2015 or later.

- Section 21.4.1, “Understanding NSS Audit Log Messages,” on page 313
- Section 21.4.2, “Enabling or Disabling LAF Audit Messages for Trustee Events,” on page 316
- Section 21.4.3, “Viewing LAF Audit Messages,” on page 317
- Section 21.4.4, “Additional Information,” on page 317

21.4.1 Understanding NSS Audit Log Messages

When the LAFAuditTrustee parameter is enabled, NSS reports changes for the following subset of NSS events:

- Adding trustees (AddTrustee)
- Removing trustees (RemoveTrustee)
- Setting the inherited rights mask (SetInheritedRightsMask)

Comma separated name value pairs are used for the NSS audit log messages. The messages are written to the`/var/log/audit/audit.log` file.

The types of information reported are described below:

- “Message Type and ID” on page 314
- “Add Trustee Event Messages” on page 314
- “Remove Trustee Event Messages” on page 314
- “Set Inherited Rights Mask Event Messages” on page 314
- “Trustee Rights” on page 315

- “Inherited Rights Mask for Trustee Rights” on page 315
- “Special Rights” on page 315
- “Inheritance Attributes” on page 316

Message Type and ID

All NSS Audit Log messages are of the type AUDIT_KERNEL_OTHER (1316) for LAF. For example, the log messages begin

```
type=UNKNOWN[1316] msg=audit(message_id):
```

Add Trustee Event Messages

The general format of NSS audit log messages for a single AddTrustee event is:

```
NSS: AddTrustee: fsuid=<user requesting the
operation>,vol=<VOLNAME>,path=<FULL_PATH (relative to the
volume)>,trustee=<typeful Fully Distinguished eDirectory username of the
trustee being added>,rights=<RIGHTS>,attributes=<ATTRIBUTES>
```

For example, the following message is for a single event for adding a trustee:

```
type=UNKNOWN[1316] msg=audit(1164926678.066:7): NSS: AddTrustee:
fsuid=0,vol=NSS1,path=/abc/
a,trustee=.CN=user5.O=company.T=COMPANY_TREE.,rights=0x1fb,attributes=0xc0
00
```

In this example, the trustee user5.company.company_tree is assigned the SRWCEMFA rights, totaling 0x1fb. For a map of rights to values, see “Trustee Rights” on page 315.

Remove Trustee Event Messages

The general format of NSS audit log messages for a single RemoveTrustee event is:

```
NSS: RemoveTrustee: fsuid=<user requesting the
operation>,vol=<VOLNAME>,path=<FULL_PATH (relative to the
volume)>,trustee=<typeful Fully Distinguished eDirectory username of the
trustee being removed>
```

For example, the following message is for a single event for removing a trustee:

```
type=UNKNOWN[1316] msg=audit(1164926734.422:8): NSS: RemoveTrustee:
fsuid=0,vol=NSS1,path=/abc/a,trustee=.CN=user5.O=company.T=COMPANY_TREE.
```

Set Inherited Rights Mask Event Messages

The general format of NSS audit log messages for a single SetInheritedRightsMask event is:

```
NSS: SetInheritedRightsMask:
fsuid=<user>,vol=<VOLNAME>,path=<FULL_PATH(relative to the
volume)>,inheritedRightsMask=<RIGHTS>
```

For example, the following message is for a single event for changes to the inherited rights mask:

```
type=UNKNOWN[1316] msg=audit(1164926882.005:10): NSS:
SetInheritedRightsMask: fsuid=0,vol=NSS1,path=/abc/
a,inheritedRightsMask=0x149
```

In this example, the trustee rights settings can be inherited from the parent directory for the Supervisor (0x0100), Read (0x0001), Create (0x0008), and File Scan (0x0040) rights, totaling 0x0149.

Trustee Rights

The file system trustee rights setting in the message is a hexadecimal value that represents the combination of rights assigned.

The following table maps the trustee rights to hexadecimal values. The values for enabled rights are added to get the reported value for the Rights and Inherited Rights Mask.

Trustee Right	Hexadecimal Value
Supervisor (S)	0x0100
Read (R)	0x0001
Write (W)	0x0002
Create (C)	0x0008
Erase (E, Delete)	0x0010
Modify (M)	0x0080
File Scan (F, See Files)	0x0040
Access Control (A)	0x0020

For example, if the trustee has SRWCEMFA rights, the value is the sum of these or 0x1fb in hexadecimal.

Inherited Rights Mask for Trustee Rights

An inherited rights mask (IRM) specifies which trustee rights are allowed to be inherited downward through a directory. If a trustee bit is set in the IRM of a directory, that bit can be inherited downward in the tree. If a trustee bit is not set in the IRM of a directory, then that right cannot be inherited by the directory's contents, even if a higher level in the directory tree had that right.

The bit definitions for inherited rights masks are the same bits as the trustee rights themselves as described in “Trustee Rights” on page 315. For example, if the Read and File Scan rights can be inherited, the inherited rights mask value is 0x0041 in hexadecimal.

Special Rights

In addition to trustee rights, the following are special rights that might be reported in the Rights field. They cannot be inherited.

Special Right	Hexadecimal Value
Salvage	0x0200
Secure	0x8000

Inheritance Attributes

The attributes reported in the log are flags that tell the trustee how it gets inherited. (They are not file system attributes.) By default, the NetWare trustee model inherits downward and upward (visibility inherits upward; actual rights inherit downward).

The following table maps the inheritance attributes to hexadecimal values. The values for enabled inheritance attributes are added to get the reported value for the Attributes parameter.

Inheritance Attribute	Hexadecimal Value
Inherit Down Make rights inherit downward.	0x8000
Inherit Up Make directories above this file visible.	0x4000
Negative Rights (Not currently used) All other bits are ignored if this parameter is set.	0x2000

For example, an Attribute value of 0xc000 in the audit message indicates that both the Inherit Down and Inherit Up parameters are enabled. This is the typical setting for NSS file systems.

21.4.2 Enabling or Disabling LAF Audit Messages for Trustee Events

Enable or disable the generation of audit messages via LAF for NSS trustee changes. After you enable the audit log messages, the setting persists until the server reboot. After a server reboot, the audit log is disabled again by default. To make the command persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file. The messages are written to the`/var/log/audit/audit.log` file.

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, do one of the following:
   - **Enable:** To enable audit messages for an NSS volume, enter

     ```
     nss /LAFAuditTrustee
     ```

   - **Disable:** To disable audit messages for an NSS volume, enter

     ```
     nss /NoLAFAuditTrustee
     ```

21.4.3 Viewing LAF Audit Messages

View audit messages in the `/var/log/audit/audit.log` file.

For information about the format of the messages, see Section 21.4.1, “Understanding NSS Audit Log Messages,” on page 313.

21.4.4 Additional Information

For information about configuring Linux Audit, see the *Linux Audit Quick Start* (https://www.suse.com/documentation/sles11/singlehtml/audit_quickstart/audit_quickstart.html).

22 Managing Compression on NSS Volumes

OES Storage Services file compression uses algorithms to reduce the amount of space a file consumes in your storage system. Compression can optionally be used to conserve disk space and increase the amount of data a volume can store. No data in the file is permanently eliminated to compress the file; all original data is recovered when the file is decompressed.

This section describes the following:

- Section 22.1, “Understanding Compression,” on page 319
- Section 22.2, “Configuring Compression for a Server,” on page 324
- Section 22.3, “Configuring a Volume for Compression,” on page 329
- Section 22.4, “Suspending Compression for Volumes or Files,” on page 331
- Section 22.5, “Disabling Compression for a Volume,” on page 331
- Section 22.6, “Restoring Data to a Uncompressed Volume,” on page 331
- Section 22.7, “Configuring Compression Preferences for Directories and Files,” on page 331
- Section 22.8, “Using NSS Commands to Configure and Monitor Compression,” on page 334
- Section 22.9, “Repairing Compressed Volumes with the Compfix Utility,” on page 335
- Section 22.10, “Backing Up Compressed Files,” on page 335

22.1 Understanding Compression

This section describes the following:

- Section 22.1.1, “Compression and Decompression Processes,” on page 319
- Section 22.1.2, “Compression Settings,” on page 320
- Section 22.1.3, “Guidelines for Compression,” on page 321
- Section 22.1.4, “Factors Affecting Compression,” on page 323
- Section 22.1.5, “Factors Affecting Decompression,” on page 324
- Section 22.1.6, “Monitoring Compression Activity,” on page 324

22.1.1 Compression and Decompression Processes

For each compressed volume, the file compression and decompression processes occur in the background as needed for each compressed volume, to support normal file access and immediate file compression settings. Scheduled compression occurs during a specified time each day. The scheduled period is usually set to non-peak hours, but it can be set for any time you prefer.

A file must be idle for the period specified in the Days Untouched before Compression parameter before it is considered eligible for a scheduled compression. During a scheduled compression, NSS evaluates file time stamps and all compression settings to determine which files qualify for

compression. When NSS queues eligible files for compression, the compression process begins and handles as many compression tasks as it can in the available time. Any remaining files are queued for the next compression opportunity.

To minimize the impact of compression and decompression on system performance, you can limit the maximum number of concurrent process threads. The system queues the compression and decompression requests and then processes them as the threads become available.

NSS retains the uncompressed file during the compression process. Before NSS compresses a file, it verifies that the file system has enough space available for both the uncompressed file and the compressed file to temporarily coexist. If there is not enough space available, the file is not compressed. You must make free space available for the volume before the file can be opened. After the compression finishes successfully, NSS deletes the uncompressed file and keeps the compressed file. If error occurs during compression, NSS discards the compressed file and marks the uncompressed file with a Cannot Compress (Cc) attribute.

NSS does not attempt to compress a file while its Cc attribute is set to On. If the file is opened and saved, its Cc attribute is reset to Off. You can also run the Compfix utility to clear the Cc attribute. For more information, see Section 22.9, “Repairing Compressed Volumes with the Compfix Utility,” on page 335.

22.1.2 Compression Settings

Although the cost of storage media is decreasing, you might consider compression to store more information on media where available space is limited. File compression requires configuration for the server level, for the volume, and optionally for individual directories and files.

Common Service Compression Parameters

At the server level, the settings for compression parameters in Common Services govern when and how compression works for the NSS volumes where the compression attribute is enabled. For information about these parameters, see Section 22.2, “Configuring Compression for a Server,” on page 324.

The Volume’s Compression Attribute

The volume’s Compression attribute determines if its files can be compressed. You can enable the attribute when you create a new volume or add it at any time for an existing volume. After it is set, the Compression attribute persists for the life of the volume. For information about setting attributes for existing volumes, see Section 22.3, “Configuring a Volume for Compression,” on page 329.

Compression Preferences for Directories and Files

For individual directories and files, you can optionally set compression preferences that allow file compression to occur immediately for specified files, regardless of the server’s compression parameters. You can also specify restrictions for individual files that make them ineligible for compression. For information about how to set compression preferences for individual directories and files, see Section 22.7, “Configuring Compression Preferences for Directories and Files,” on page 331.

22.1.3 Guidelines for Compression

To effectively use compression for your NSS volumes, you must understand the following key concepts:

- "Some Volumes Are Not Good Candidates for Compression" on page 321
- "After It Is Set, the Compression Attribute Persists for the Life of the Volume" on page 321
- "Inactivity Determines Which Files Are Eligible for Background Compression" on page 321
- "Some Files Do Not Compress Well" on page 322
- "Decompression Activity Depends on Available Space" on page 322
- "Immediate Compression Impacts CPU Performance" on page 323
- "Files Remain Compressed during Backup and Restore" on page 323

Some Volumes Are Not Good Candidates for Compression

Compression is not recommended for the `sys:` volume. Reserve compression for user data volumes.

You cannot use compression on an NSS volume on a CD or DVD drive.

After It Is Set, the Compression Attribute Persists for the Life of the Volume

The Compression attribute for a volume can be set when you create the NSS volume, or it can be set at any time thereafter. After you set the Compression attribute for a volume, you cannot turn it off; the parameter is in effect for the life of the volume.

You can suspend the compression activity, as needed, by using the Enable File Compression parameter. This parameter suspends compression for all volumes on the server. For information, see Section 22.4, "Suspending Compression for Volumes or Files," on page 331 and Section 22.5, "Disabling Compression for a Volume," on page 331.

If you want to turn off file compression permanently, you must uncompress the data, back up the volume in its uncompressed state, then restore the uncompressed data to a new volume on which the Compression attribute is not set.

Inactivity Determines Which Files Are Eligible for Background Compression

NSS compresses files based on the interval of time that a file remains inactive. With background compression, files automatically pass in and out of their compressed state as they are unused and qualify for compression, then are accessed and uncompressed. It is not necessary to separate application files from data files for file compression. Most application files are used regularly and are not inactive long enough to qualify for compression.

Use the compression parameter named Days Untouched before Compression to set the length of the interval of inactivity. The parameter uses the date the file was last accessed for reading or writing to determine if a file is inactive, and therefore, eligible for compression.

To determine the optimal period of inactivity to use, consider the frequency of use of different types of files and your compression goals. Application files tend to be used more frequently, while user data is used less frequently. For example, the shorter the period of inactivity is, the higher the frequency of compression. The longer the period of inactivity is, the lower the frequency of compression, and the less likely it is that files are ever compressed.

If the volume is on a shared pool, its files might be queued for compression on one node, when its pool is cluster migrated or failed over to another node. The Compression Queue is non-persistent, so on the new node, the volume does not have information about the compression queue from the old node. Therefore, the files must re-qualify for compression when the Background Compression starts on the new node.

Some Files Do Not Compress Well

A file must be larger than 8 KB and smaller than 256 MB to be eligible for compression. The compression algorithm determines these limits.

To avoid the overhead of decompressing files that do not compress well, the system calculates the compressed size of a file before actually compressing it. If no disk space is saved by compression, or if the size difference does not meet the value specified by the set command's Minimum Percentage Compression Gain parameter, the file is not compressed.

NSS does not compress NSS sparse files. A sparse file contains numerous contiguous zeros that NSS stores in a special way to conserve space. A sparse file's logical size is larger than its physical disk usage. If a sparse file were compressed, it would actually consume more storage space than it normally does.

Some database files become unavailable when they are compressed, such as Sybase database files.

IMPORTANT: If you use Sybase database files in a volume, such as for ZENworks databases, do not enable compression on the volume, or mark each database file with the Don't Compress (Dc) attribute so that it is never compressed even if compression is enabled for the volume. For details, see *Technical Information Document 10075966* (http://support.novell.com/cgi-bin/search/searchtid.cgi?/10075966.htm).

Decompression Activity Depends on Available Space

Compressed files are uncompressed as they are needed, then remain uncompressed until they are inactive for a designated period. For a file to be uncompressed, there must be enough free space on the volume to accommodate the decompression process and the uncompressed file size.

Immediate Compression Impacts CPU Performance

Compression requires processor resources, memory resources, and hard disk space during the compression and decompression processes. Compression is usually a low-priority process thread because of compression's impact on performance. If you flag many large files for immediate compression during peak system usage, CPU performance might deteriorate.

You can configure the server's compression parameters to control how compression services use resources. For example, you can schedule compression to occur only during non-peak hours to free CPU resources during peak and normal hours. For information, see Section 22.2, "Configuring Compression for a Server," on page 324.

Files Remain Compressed during Backup and Restore

OES Storage Management Services (SMS) backs up and restores compressed files in their compressed state. It does not compress uncompressed files for backup; they are stored and restored in their uncompressed state. For more information, see Section 22.10, "Backing Up Compressed Files," on page 335.

22.1.4 Factors Affecting Compression

Typically, files that have been inactive for a specified period of time set in the Days Untouched before Compression parameter are eligible for compression.

The Immediate Compression attribute for a file or directory can also be used to identify files for compression:

- Files residing in a directory marked for immediate compression
- Files residing in subdirectories of a directory marked recursively for immediate compression
- Individual files that are marked for immediate compression

Several factors prevent an uncompressed file from being compressed, even if it meets inactivity criteria:

- The file has not been inactive for a period longer than the value in Days Untouched before Compression parameter when the compression daily check begins and compares the file's time stamp to the starting time. The daily check is controlled by the Compression Daily Check Starting Hour parameter.
- The file is flagged with a Don't Compress (Dc) attribute. For information, see Section 22.7, "Configuring Compression Preferences for Directories and Files," on page 331.
- The file is an NSS sparse file, so its physical storage size is already minimized. A sparse file contains numerous contiguous zeros that NSS stores in a special way to conserve space.
- The amount of space freed by compressing a file does not meet the specified minimum reduction criteria. For example, if the Minimum Compression Percentage Gained parameter is set to 20%, a file would not be compressed if compression reduced its file size by only 10%.
- The file compression service is suspended. For information, see Section 22.4, "Suspending Compression for Volumes or Files," on page 331.

- The queue of files marked for compression is long and cannot be completed during the specified hours set aside for compression activities. For information on how to modify the Compression Daily Check Stop Hour, see Section 22.2, “Configuring Compression for a Server,” on page 324.
- The volume does not contain enough space to hold both the original version and the compressed version of the file while compression occurs.
- The file has been deleted, and the Deleted File Compression Option parameter does not allow compression of deleted files. For information on how to modify this setting, see Section 22.2, “Configuring Compression for a Server,” on page 324.

22.1.5 Factors Affecting Decompression

Decompression occurs as needed to support file access, but other factors affect whether the uncompressed version or compressed version of the file remains in the volume after the access. The files remain compressed in the following cases:

- The percentage of free disk space available on the volume is insufficient to allow a decompressed file to remain in its uncompressed state.
- The Convert Compressed to Uncompressed Option parameter requires that compressed files always remain compressed.
- The file was opened for the first time for viewing only and the Convert Compressed to Uncompressed Option parameter requires that the file must be opened at least twice for viewing or opened once for modification before the file remains uncompressed after access.

  Whenever you open a compressed file, NSS decompresses the file, but it keeps the compressed copy of the file while the file is open. The first time you open a compressed file for viewing only, NSS discards the decompressed copy of the file when you close the file. The compressed file remains on the system. If you open the file a second time for viewing only, the file is considered active. When you close the file, NSS keeps the uncompressed file and discards the compressed copy of the file. If you modify the file and save it, NSS saves the uncompressed file, then discards the compressed file.

22.1.6 Monitoring Compression Activity

Monitor compression activity using the `nss /compscreen` command. For instructions, see Section 22.8, “Using NSS Commands to Configure and Monitor Compression,” on page 334.

22.2 Configuring Compression for a Server

The server’s compression parameters govern compression behavior for all NSS volumes on your server. The server-level settings apply to all files and directories in compression-enabled NSS volumes, but some settings can be overridden by individual file or directory attributes.

Before you set parameters, make sure you understand how compression works for NSS. For information, see Section 22.1, “Understanding Compression,” on page 319.

- Section 22.2.1, “Understanding Server-Level Compression Parameters,” on page 325
- Section 22.2.2, “Configuring Server-Level Compression Parameters with Commands,” on page 328

22.2.1 Understanding Server-Level Compression Parameters

The following table describes each compression parameter, its purpose, supported values, and default value.

Table 22-1 *Explanation of Compression Parameters*

Parameter	Description
Days Untouched Before Compression	Specifies the number of days the system waits after a file was last accessed before it is compressed. The parameter uses the date the file was last accessed for reading or writing to determine if a file is inactive, and therefore, eligible for compression. When background compression starts, it first evaluates which files meet this inactivity requirement to determine which files are to be compressed during the compression period. To effectively stop compression for a volume, set the elapsed time very high. Eventually, files are decompressed and remain uncompressed because they never cross the inactivity threshold. **Range:** 0 to 100000 **Default:** 14
Compression Daily Check Starting Hour	Specifies the hour when you want the file compressor to start scanning enabled volumes for files that need to be compressed and to compress them. If the Compression Daily Check Stop Hour parameter is the same as the Compression Daily Check Starting Hour, then the file compressor starts checking every day at the Compression Daily Starting Hour time and runs as long as necessary to finish all files that meet the compressible criteria. **Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default:** 0
Compression Daily Check Stop Hour	Specifies the hour when you want the file compressor to stop scanning enabled volumes for files that need to be compressed and to stop compressing them. **Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default:** 6

Parameter	Description
Enable File Compression	Specifies whether file compression is enabled or suspended for all volumes where the Compression attribute is enabled. After an NSS volume's Compression attribute is enabled, it cannot be turned off because the volume contains compressed files and metadata about compression. The server-level Enable File Compression parameter allows you to turn off the compression of more files on the server's compressed volumes. While file compression is suspended, files that would have been compressed are queued for compression, then are compressed only when (or if) the Enable File Compression parameter is reset to On. Files that are already compressed remain compressed, unless they are decompressed when they are opened and used. **Range:** On (default) or Off The On setting allows file compression activity to occur on volumes where the Compression attribute is enabled. It does not enable the Compression attribute on the server's volumes. The Off setting suspends compression on volumes where the Compression attribute is enabled. Immediate compression requests are queued until the value is reset to On, when the files meeting criteria are compressed. The Off setting does not disable the Compression attribute on individual volumes, and it does not prevent you from enabling the Compression attribute for a volume. **Default:** On
Minimum Compression Percentage Gain	Sets the minimum percentage a file must compress to remain in a compressed state. **Range:** 0 to 50 **Default:** 20
Maximum Concurrent Compressions	Specifies the maximum concurrent or simultaneous compressions allowed. **Range:** 1 to 8 **Default:** 2

Parameter	Description
Convert Compressed to Uncompressed Option	Specifies what the file system does with an uncompressed version of a file after the server has decompressed it. **IMPORTANT:** Before a compressed file can be opened, there must be sufficient space available on the volume for the uncompressed and compressed copies of the file to coexist while the file is open. **Range:** 0, 1 (default), or 2 0 = Always leave the file compressed. While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. If the file is closed without changes, the uncompressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. After the modified file is closed, it is queued for immediate compression. Sufficient space must be available for both the compressed and uncompressed copies of the file to temporarily coexist on the volume in order for the compression to occur. After successful compression, the uncompressed copy of the modified file is discarded. 1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter. This is the default behavior for compression. While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. The first time that the file is closed without changes in the specified period, the uncompressed copy of the file is discarded. The second time that the file is closed without changes in the specified period, the compressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed. 2 = Always leave the file uncompressed. While the compressed file is open, both the uncompressed and compressed copies of the file coexist on the volume. When the file is closed or when changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.
Decompress Percent Disk Space Free to Allow Commit	Specifies the percentage of free disk space required on a volume for file decompression to permanently change compressed files to decompressed. This parameter prevents newly decompressed files from filling up the volume. **Range:** 0 to 75 **Default:** 10
Decompress Free Space Warning Interval	Specifies the time between alerts when the file system is not changing compressed files to decompressed because of insufficient disk space. **Range:** 0 seconds to 29 days 15 hours 50 minutes 3.8 seconds Setting the interval to 0 turns off the alert. **Default:** 31 minutes 18.5 seconds

Parameter	Description
Deleted Files Compression Option	Specifies whether and when deleted files are compressed. **Range:** 0, 1, or 2 0 = Do not compress deleted files 1 = Compress deleted files the next day 2 = Compress deleted files immediately **Default:** 1

22.2.2 Configuring Server-Level Compression Parameters with Commands

Use the following commands to modify server-level compression parameters. Issue the commands at the NSS Console (`nsscon`) as the `root` user. For details about each parameter, see Section 22.2.1, “Understanding Server-Level Compression Parameters,” on page 325.

Command	Values
nss /DaysUntouchedBeforeCompression=*value*	**Range:** 0 to 100000 (in days) **Default:** 14
nss /CompressionDailyCheckStartingHour=*value*	**Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default Value:** 0
nss /CompressionDailyCheckStopHour=*value*	**Supported Values:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default Value:** 6

nss /(No)EnableFileCompression
To enable compression, enter
`nss /EnableFileCompression`
To disable compression, enter
`nss /NOEnableFileCompression`
	Supported Values: On (default) or Off
	Default Value: On

nss /MinimumCompressionPercentageGain=*value*	**Supported Values:** 0 to 50 **Default Value:** 20
nss /MaximumConcurrentCompressions=*value*	**Supported Values:** 1 to 8 **Default Value:** 2

Command	Values
nss /ConvertCompressedToUncompressedOption=*value*	**Supported Values:** 0, 1, or 2 0 = Always leave the file compressed 1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter 2 = Always leave the file decompressed **Default Value:** 1
nss /DecompressPercentDiskSpaceFreeToAllowCommit=*value*	**Supported Values:** 0 to 75 **Default Value:** 10
nss /DecompressFreeSpaceWarningInterval=*value*	**Supported Values:** 0 seconds to 29 days 15 hours 50 minutes 3.8 seconds Setting the interval to 0 turns off the alert. **Default Value:** 31 minutes 18.5 seconds
nss /DeletedFilesCompressionOption=*value*	**Supported Values:** 0, 1, or 2 0 = Do not compress deleted files 1 = Compress deleted files the next day 2 = Compress deleted files immediately **Default Value:** 1

22.3 Configuring a Volume for Compression

To use compression on a volume, set the volume's Compression attribute to On. You can set the Compression attribute when you create a new volume or enable the attribute for an existing non-compressed volume.

After you enable compression for a volume, you can suspend compression, but you cannot turn the Compression attribute off. For more information, see Section 22.4, "Suspending Compression for Volumes or Files," on page 331.

IMPORTANT: You cannot use file compression on a volume on a CD or DVD drive.

- Section 22.3.1, "Enabling Compression for a New Volume," on page 330
- Section 22.3.2, "Enabling Compression for an Existing Volume," on page 330

22.3.1 Enabling Compression for a New Volume

When you create a new volume, simply select the **Compression** check box when you set the volume's attributes. For information, see Section 19.3, "Creating Unencrypted NSS Volumes," on page 268.

22.3.2 Enabling Compression for an Existing Volume

1. In iManager, click **Storage > Volumes** to open the Volumes page.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

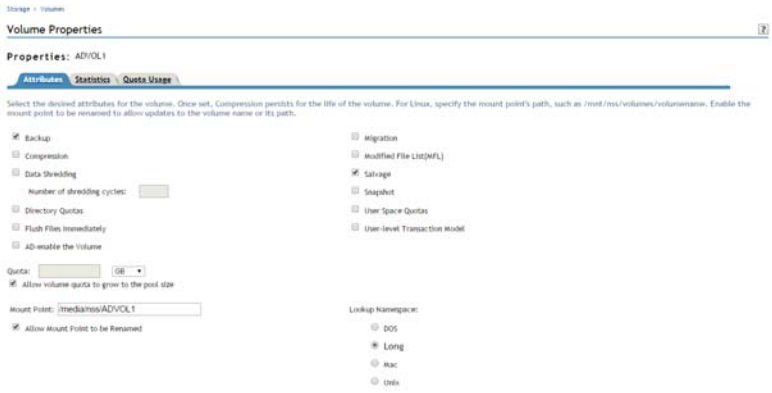
2. Select a server to manage.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

3. From the **Volumes** list, select the volume that you want to manage.

4. Click **Properties > Attributes**.

   This opens the **Volume Properties** to the **Attributes** page.



5. Select the **Compression** check box to enable file compression for the selected volume.

   IMPORTANT: After compression is enabled for a volume, you cannot deselect the **Compression** check box to turn off compression. You can suspend compression or restore uncompressed data to an uncompressed volume. For information, see Section 22.4, "Suspending Compression for Volumes or Files," on page 331 or Section 22.6, "Restoring Data to a Uncompressed Volume," on page 331.

6. Click **Apply** or **OK** to save the change, or click **Cancel** to back out of the process.

   If you click **Apply**, iManager saves the change and remains on the Volumes page. If you click **OK**, iManager saves the change and takes you to the main Storage page. If you do not click **Apply** or **OK**, the setting is not implemented; the volume remains uncompressed.

22.4 Suspending Compression for Volumes or Files

You can temporarily suspend file compression for all volumes by using the `Set` command's Enable File Compression parameter. While file compression is suspended, files that would have been compressed are queued for compression, then compressed when compression is re-enabled. For information, see Section 22.7, "Configuring Compression Preferences for Directories and Files," on page 331.

You can suspend compression for a file by setting its Don't Compress flag. For information, see Section 22.7, "Configuring Compression Preferences for Directories and Files," on page 331.

22.5 Disabling Compression for a Volume

After compression is enabled for an NSS volume, you cannot deselect the **Compression** attribute check box to turn off compression. Use one of the following methods to disable compression for a volume.

- To effectively stop compression for a volume, set the Days Untouched Before Compression parameter's elapsed time to the maximum value. Eventually, files are decompressed as they are used and remain uncompressed because they never cross the threshold for inactivity.
- Restore the data to an uncompressed volume. For information, see Section 22.6, "Restoring Data to a Uncompressed Volume," on page 331.
- Set Enable File Compression to Off. Eventually, files are decompressed as they are used and remain uncompressed.

22.6 Restoring Data to a Uncompressed Volume

1. Decompress the volume data.
2. Back up the uncompressed data.
3. Create a new volume with the Compression attribute disabled.
4. Restore the old volume contents as uncompressed data from your backup media.

22.7 Configuring Compression Preferences for Directories and Files

File and directory compression preferences override the compression settings for the volume and server.

- Section 22.7.1, "Using the Client for Open Enterprise Server," on page 332
- Section 22.7.2, "Using ATTRIB," on page 332

22.7.1 Using the Client for Open Enterprise Server

1. From a workstation, click the Client for Open Enterprise Server icon (the icon in the notification area), select **OES Map Network Drive**, then map a drive to the NSS volume by using the login and password of the Administrator user.
2. Use the following method to open the **OES Info** dialog box for the file or directory you want to manage:

   In a file manager, navigate to the directory or file you want to manage. Right-click the directory or file, select **Properties**, then select the **OES Info** tab in the **Properties** window.
3. Do any of the following:
   - Select its check box to enable (set) the **Don't Compress** or **Immediate Compression** attribute.
   - Deselect its check box to disable (clear) the **Don't Compress** or **Immediate Compression** attribute.
4. Click **OK** or **Apply** to accept the changes, or click **Cancel** to back out of the process.

22.7.2 Using ATTRIB

Use the ATTRIB utility at the Linux terminal console prompt to view or modify file and directory attributes for compression on NSS volumes where compression is enabled.

Syntax

`attrib [options] [filename]`

Options

If both the set and clear options are selected, the clear option is completed before the set option. If the *filename* is not specified, the operation is completed on the current directory.

Table 22-2 *Operations Options for the ATTRIB Utility*

Option	Description
-s, --set=ATTRIBUTES	Sets the attributes on the specified file or directory.
-c, --clear=[ATTRIBUTES | all]	Clears the attributes on the specified file or directory.

Compression Attributes Options

Table 22-3 *Compression Attributes Options for the ATTRIB Utility*

Attribute	Description	Applies to Files	Applies to Directories
dc	Don't Compress keeps data from being compressed. This attribute overrides settings for automatic compression of files not accessed within a specified number of days.	Yes	No
ic	Immediate Compression sets data to be compressed as soon as a file is closed. If applied to a directory, every file in the directory is compressed as each file is closed. The files in the specified directory are compressed as soon as the operating system can perform the operation after the file is closed. This does not apply to the directory's subdirectories and the files in them.	Yes	Yes

For example, to set the Don't Compress attribute for all files in the current directory, enter

```
attrib --set=dc
```

To clear the Immediate Compression attribute from the `/usr/course/winter/students.sxi` file, enter

```
attrib --clear=ic /usr/course/winter/students.sxi
```

Viewing Compression Status for Files and Directories

Enter `attrib` without options to show the compression attribute information for a specified file or for all files in the directory. You cannot modify Status attributes.

Table 22-4 *Compression Status for the ATTRIB Utility*

Status	Description
cc	Cannot Compress (status display only) displays if the file cannot be compressed because of limited space savings.
cm	Compressed (status display only) indicates whether the file is currently stored in compressed format.

To view the compression status of a file, enter the following at the server console:

```
attrib filename
```

Replace *filename* with the path to the file. For example, to view the attributes of the `/usr/course/winter/students.sxi` file, enter

```
attrib /usr/course/winter/students.sxi
```

To view the compression attributes of all files in the current directory, enter

attrib

22.8 Using NSS Commands to Configure and Monitor Compression

NSS offers the following commands for configuring and monitoring compression. Issue the commands at the NSS Console (nsscon) as the root user.

Table 22-5 *Compression Management Commands*

Command	Description
nss /Compression=*volume_name*	Enables the Compression attribute for the specified volume.
nss /Compression=all	Enables the Compression attribute for all volumes on the server.
nss /StopNormalCompression	Stops all queued compression for files, based on the compression triggered by a file open or close.
nss /BGCompression	Allows compression to occur in the background at any time, instead of only within specified hours.
nss /NoBGCompression	Stops background compression and clears all the enqueued background compression request. Allows compression to occur only within the specified hours.
nss /CompressionDailyCheckStartingHour	Starts scanning each enabled volume for files that need to be compressed at the specified hour (Range = 0 - 23, where 0=midnight, 23=11p.m).
nss /CompressionDailyCheckStopHour	Ends scanning each enabled volume for files that need to be compressed at the specified hour (Range = 0-23, where 0=midnight, 23=11p.m). **NOTE:** If CompressionDailyCheckStopHour is equal to CompressionDailyStartingHour then the start checking every day at CompressionDailyStartingHour and run as long as necessary to finish all files meeting the compressible criteria. [Value=6, Range=0-23].
nss /DaysUntouchedBeforeCompression	The number of days to wait after a file was last accessed before automatically compressing it. [Value=14, Range=0-100000].
nss /DeletedFilesCompressionOption	Options to compress the deleted files. 0 = do not compress the files, 1= compress next day, 2=compress immediately. [Value=1, Range=0-2].

Command	Description
`nss /(No)EnableFileCompression`	Allows file compression to occur on compression enabled volumes. If disabled, the compression does not happen. Immediate compress requests are queued until compression is allowed. [Value=ON].
`nss /MaximumConcurrentCompressions`	Maximum number of simultaneous compressions allowed by the system (simultaneous compressions can only occur if there are multiple volumes). [Value=2, Range=1-8].
`nss /MinimumCompressionPercentageGain`	Minimum percentage a file must compress in order to remain compressed. [Value=20 Range=0-50]

22.9 Repairing Compressed Volumes with the Compfix Utility

Use the Compfix utility to repair compression information for compressed volumes or to clear the Cannot Compress attribute for files in the compressed volume. For information, see Section B.2, “compfix,” on page 486.

22.10 Backing Up Compressed Files

When you back up a compressed volume, files are written to the backup media in compressed or uncompressed format, according to how they are currently stored. To back up compressed files in uncompressed format, you must decompress the files first, then back up the files.

When you recover a volume, the files are restored in their saved format to the destination volume. If you try to restore a compressed file to a volume without compression, the file is not readable. For information, see “Backing Up Compressed files” in the *OES 2018 SP3: Storage Management Services Administration Guide for Linux*, or see your third-party backup application’s documentation.

23 Managing Space Quotas for Volumes, Directories, and Users

This section describes how to manage space quotas for volumes, directories, and users of OES Storage Services (NSS) volumes.

- Section 23.1, “Understanding Space Quotas,” on page 337
- Section 23.2, “Managing NSS Volume Quotas,” on page 339
- Section 23.3, “Managing Directory Quotas,” on page 340
- Section 23.4, “Managing User Space Quotas,” on page 344

23.1 Understanding Space Quotas

You can control how space is allocated in an NSS pool or volume by restricting the amount of space available to a particular volume, directory, or user. These space restrictions, or quotas, work independently, with the lower value being the most restrictive if all constraints apply. NSS allocates the space as it is needed; the quota does not reserve the space.

If you set a quota to a value equal to or less than the current size of space in use for the specified volume, directory, or user, users cannot add files until enough files are deleted to free up space in the volume, directory, or user files. Users can continue to access existing files for which they are authorized users, but they cannot save them.

Quotas restrict the actual physical space that the volume, directory, or user is allowed to consume. When enforcing quotas, NSS considers only the actual physical blocks consumed (in 4 KB blocks), not the file’s logical size. If you have sparse files or compressed files, only the actual physical space they consume is counted against the quota. In order for a compressed file to be uncompressed, there must be enough space available in the most restrictive of the quotas set (whether volume, directory, or user) to accommodate the decompression process and the uncompressed file size. Otherwise, the user is not able to open the file. For more information about the space requirements for compressing and decompressing files, see Section 22.1.5, “Factors Affecting Decompression,” on page 324.

As the amount of space consumed by a user’s files approaches the user’s space quota, the user should use caution when saving files. Data loss can occur if the user attempts to save a file that is too large for the remaining unused space.

To get the correct disk utilization information, use NSSMU or `nsscon /SpaceInformation`. For NSS volume, used space = in-use space + purgeable space. If you use `df-h` command or any other non-NSS utility to get the disk utilization information, the output may confuse the user as it shows only in-use space and does not take account of purgeable space.

WARNING: If storing a file would cause a quota to be exceeded, only part of the file is actually saved, resulting in data corruption.

If the Salvage attribute is enabled for a volume, deleted files are not immediately purged from the volume. Deleted files on the volume are not counted against quotas.

Volume Quotas

When you create an NSS volume, you have the option of setting a space quota for the volume or letting it grow to the size of the pool. At any time thereafter, you can view and configure the volume quota from the **Storage > Volumes > Properties > Attributes** tab in iManager. For information, see Section 23.2, “Managing NSS Volume Quotas,” on page 339.

If you set a volume quota to grow to the pool size, you can also add segments to the volume’s pool to expand its size, and therefore, expand the volume quota.

As a volume nears its quota, automatic controls can be configured to manage space. For information, see Section 29.3, “Monitoring Quotas and Space Usage for NSS Pools and Volumes,” on page 408.

Directory Quotas

Directory quotas limit the space available in an individual NSS directory. To use directory quotas on an NSS volume, you must first enable the Directory Quotas attribute.

For information about configuring attributes when you create a volume, see “Understanding Volume Properties” on page 261.

For information about setting directory quotas, see Section 23.3, “Managing Directory Quotas,” on page 340

User Space Quotas

User space restrictions limit the space available to a user of the NSS volumes across all directories and files owned by the user. For information about setting user space quotas, see Section 23.4.3, “Configuring a User Space Quota,” on page 347.

You must first enable the User Space Quotas attribute on the NSS volume where you want to configure user space restrictions. You can set the attribute at any time. For information about configuring the User Space Quotas attribute for an existing volume, see “Modifying Attributes of an NSS Volume” on page 275.

Example of Directory and User Space Quotas

Quotas are beneficial for systems where you want to control how your storage resources are used. In environments such as a university, where you set up a common work area for a large number of students and you want to limit the space that directory can consume, set a Directory Quota. You might also limit the amount of space an individual user’s work can consume by setting the User Quota.

For example, if a directory’s quota is 500 MB and the user’s quota is 1 GB, the user is limited to up to 500 MB in the specific directory. If the user can access multiple directories, each with a 500 MB quota, the maximum space the user’s work can consume for all directories combined is limited to the user’s 1 GB administrative limit.

23.2 Managing NSS Volume Quotas

1 In iManager, click **Storage > Volumes**.

For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2 Select a server to manage.

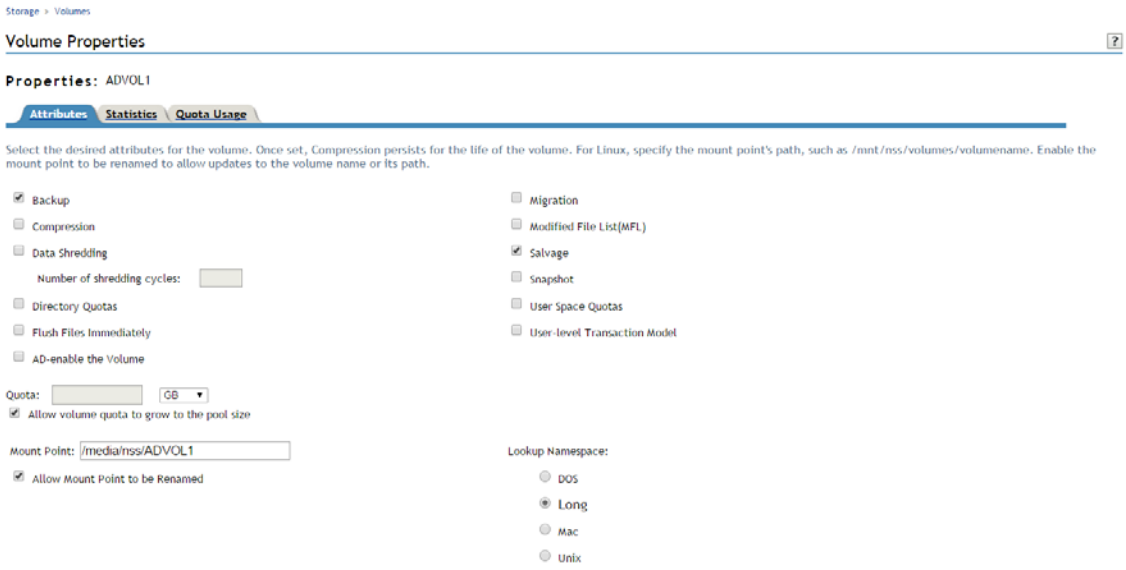
For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

A list of volumes appears in the **Volumes** list.

3 In the **Volumes** list, select a volume that you want manage.

4 Click **Properties**.

The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens to the **Attributes** tab.



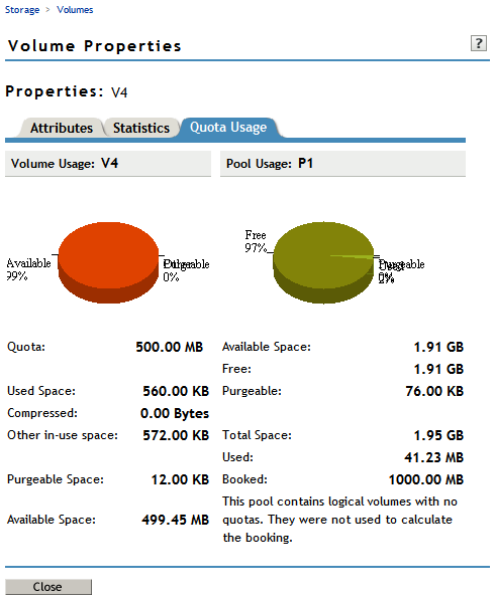
5 In the **Quota** field, do one of the following:

- **No Quota:** Select **Allow Volume Quota to Grow to the Pool Size**. NSS pools allow overbooking so the administrative sum of all volumes’ quotas in a pool can exceed the physical pool quota.
- **Quota:** Deselect **Allow Volume Quota to Grow to the Pool Size**, then specify the maximum size you want to allow volume to grow. The quota cannot exceed the pool size.

  If you set the quota to a value less than the current volume size, you cannot save files to the volume until you purge some files to make room.

6 Click **Apply**.

7 Click the **Quota Usage** tab to view the volume and pool space usage for the selected volume and to verify the new setting.



23.3 Managing Directory Quotas

A directory quota limits the amount of space on a volume that can be consumed by all of the files and folders in that directory. You can specify any positive value for the quota. If the current size of the directory exceeds the specified limit, users cannot save data to the directory until space is cleared by removing files from the directory. If the specified directory quota exceeds the volume quota, the volume quota overrides the directory quota in determining whether data can be saved to the directory as data is written. Because overbooking is allowed for directory and volume quotas, the physical space limits for the pool might also prevent the directory from growing to its specified maximum. Physical space limits for the pool override the volume and directory quotas.

For example, lets assume that volume `VOL1:` has a volume quota of 50 GB in pool `POOL1`. You set the directory quota to 100 GB for directory `VOL1:\finance\sales`. Users cannot save 100 GB of files in the `sales` directory because NSS reaches the volume quota long before it reaches the directory quota. Because of overbooking, other directories are competing for the 50 GB of space in the volume, and `VOL1:` is competing for space with other volumes in `POOL1`. You might not be able to put as much as 50 GB of data in the `sales` directory.

Setting the directory quotas on a volume will automatically enable the Directory Quotas attribute for the volume as well. As the administrator user, you can view and configure directory quotas with the Files and Folders plug-in for iManager, NetStorage, and the Client for Open Enterprise Server.

This section describes the following:

- Section 23.3.1, “Enabling or Disabling the Directory Quotas Attribute for an NSS Volume,” on page 341
- Section 23.3.2, “Configuring Directory Quotas,” on page 341
- Section 23.3.3, “Removing a Directory Quota,” on page 343
- Section 23.3.4, “Removing All Directory Quotas for an NSS Volume,” on page 343

23.3.1 Enabling or Disabling the Directory Quotas Attribute for an NSS Volume

Setting the directory quotas on a volume will automatically enable the Directory Quotas attribute for the volume as well. You can set the attribute at create time or at any time for an existing volume.

To set the Directory Quotas attribute for an existing volume:

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage to view a list of NSS volumes on the server.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select a volume that you want manage.

   Wait for the volume details to be displayed before you continue.
4. Click **Properties**.

   The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens to the **Attributes** tab.
5. On the **Attributes** tab, select or deselect the **Directory Quotas** check box, then click **Apply**.
6. If you enabled or disabled the **Directory Quotas** attribute, restart NCP2NSS by entering the following at a terminal console prompt:

   ```
   systemctl restart ncp2nss.service
   ```

23.3.2 Configuring Directory Quotas

- “Adding or Modifying a Directory Quota with iManager” on page 341
- “Adding or Modifying a Directory Quota with OES NetStorage” on page 342
- “Adding or Modifying Directory Quotas with the Client for Open Enterprise Server” on page 342

Adding or Modifying a Directory Quota with iManager

1. In iManager, select **Files and Folders > Properties**.
2. Click the **Search** icon, then browse to locate and select the folder you want to manage on an NSS volume.
3. View the current status of the Directory Quota.

   If a Directory Quota is set, the **Restrict Size** field is selected and the **Limit** field shows the quota size in KB.

   If the Directory Quota is not set, the **Restrict Size** field is deselected and the **Limit** field is dimmed (grayed out).
4. Do one of the following:
   - **Add a Quota:** On the **Information** tab, select **Restrict Size** to enable space restrictions for the selected directory. In the **Limit** field, type the directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.

- **Modify an Existing Quota:** In the **Limit** field, type the new directory quota in KB/MB/GB/TB. Select a value from the drop-down list. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
- **Remove a Quota:** On the **Information** tab, deselect **Restrict Size** to disable space restrictions for the selected directory. The **Limit** field is automatically dimmed (grayed out).

5 On the **Information** page, click **Apply** or **OK** to apply the changes.

Adding or Modifying a Directory Quota with OES NetStorage

Using OES NetStorage, you can manage directory quotas for directories in an NSS volume from any computer with a supported Web browser. This requires you to first configure a NetStorage server in the same context. For information, see the *OES 2018 SP3: NetStorage Administration Guide for Linux*.

To create or modify NSS directory quotas with NetStorage:

1 In a Web browser, connect to NetStorage.

For information, see Section 10.4, “OES NetStorage,” on page 117.

2 Log in to NetStorage with the username and password of the Administrator user or equivalent user.

3 Navigate to the directory you want to manage.

4 Right-click the directory, then select **Properties**.

5 Click the **NetWare Info** tab.

Although the option label refers to NetWare, you can use the option for your NSS and NCP volumes on Linux.

6 Do one of the following to configure the directory quota:

- **Space Restriction:** Select **Restrict Size**, then specify the directory quota in KB. The value must be a multiple of 4.
- **No Space Restriction:** Deselect **Restrict Size** to set the directory quota to Unlimited.
- **Complete Space Restriction:** Select **Restrict Size**, then specify the directory quota as 0 KB. If the directory already contains files and subdirectories, the directory cannot grow beyond the current space consumed.

7 Click **Apply** to accept the directory quota configuration.

Adding or Modifying Directory Quotas with the Client for Open Enterprise Server

The Client for Open Enterprise Server allows the Administrator user to manage directory quotas for directories in an NSS volume from a Windows computer.

1 In the Client for Open Enterprise Server, map a drive to the NSS directory you want to manage, or map to its parent directory.

1a Right-click the **Client for Open Enterprise Server** icon (the icon in the notification area), then select **OES Map Network Drive**.

1b Specify the network path to the directory. For example: `192.168.1.1/users`.

1c Specify the username of the Administrator user or equivalent user, then click **Map**.

1d When prompted, enter the user's password.

2 In a file browser, locate and right-click the directory you want to manage, then click **Properties > OES Info**.

3 In the **Space Restriction** field, click **Change** to open the **Space Restriction** dialog box.

4 Do one of the following to configure the directory quota:

- **Space Restriction:** Specify the directory quota in KB. The value must be a multiple of 4.
- **No Space Restriction:** Select **No Space Restriction** to set the directory quota to Unlimited.
- **Complete Space Restriction:** Select **Complete Space Restriction** to set the directory quota to 0 KB. If the directory already contains files and subdirectories, the directory cannot grow beyond the current space consumed.

5 Click **OK** to accept the directory quota.

23.3.3 Removing a Directory Quota

1 In iManager, select **Files and Folders > Properties**.

2 Click the **Search** icon, then browse to locate and select the folder you want to manage on an NSS volume.

3 On the **Information** tab, deselect **Restrict Size** to disable space restrictions for the selected folder.

4 Click **Apply** or **OK** to apply the changes.

23.3.4 Removing All Directory Quotas for an NSS Volume

To delete the directory quotas for all directories on an NSS volume without dealing individually with each directory, you can simply disable the Directory Quotas attribute for the NSS volume.

1 In iManager, click **Storage > Volumes**.

For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2 Select a server to manage.

For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

A list of volumes appears in the **Volumes** list.

3 In the **Volumes** list, select a volume that you want manage.

4 Click **Properties**.

The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens to the **Attributes** tab.

5 On the **Attributes** tab, deselect the **Directory Quotas** check box, then click **Apply**.

6 Restart NCP2NSS by entering the following at a terminal prompt:

```
systemctl restart ncp2nss.service
```

23.4 Managing User Space Quotas

User space quotas are the space restrictions you optionally set for users of an NSS volume. Setting the user space quotas on a volume will automatically enable the User Space Quotas attribute for the volume as well. The Users with Quotas page of the Storage plug-in reports the quota setting and space usage for each user who has space restrictions in place for a specified volume, whether the user has data stored on the volume or not. To mange the user quotes of AD users, you could use the NSS command line utilities or NFARM.

NOTE: If the user gets deleted, it's corresponding associated files does not get deleted and the ownership does not change which may cause quota inconsistency.

This section describes the following:

- Section 23.4.1, “Setting the User Space Quotas Attribute for an NSS Volume,” on page 344
- Section 23.4.2, “Viewing User Space Quotas,” on page 345
- Section 23.4.3, “Configuring a User Space Quota,” on page 347
- Section 23.4.4, “Modifying a User Space Quota,” on page 347
- Section 23.4.5, “Deleting a User Space Quota,” on page 349
- Section 23.4.6, “Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1,” on page 349

23.4.1 Setting the User Space Quotas Attribute for an NSS Volume

The administrator user can view and modify the User Space Quotas attribute at any time.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.
2. Select a server to manage to view a list of its volumes.

   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.
3. In the **Volumes** list, select a volume that you want manage, then wait for the page to refresh to view its details.
4. Click **Properties**.

   The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens to the **Attributes** tab.
5. On the **Attributes** tab, select (enable) or deselect (disable) the **User Space Quotas** check box, then click **Apply**.

23.4.2 Viewing User Space Quotas

As the Administrator user or a user with the Supervisor right for the volume can view and configure user space quotas with the Storage plug-in for iManager.

The **Users with Quotas** page reports the quota setting and space usage for each user who has space restrictions in place for a specified volume, whether the user has data stored on the volume or not. The **All Users** page reports the current usage of all users on the volume who have data stored on the volume, whether the users have a quota on the volume or not.

The tracking of user space usage and quotas is an expensive operation in terms of performance. For this reason, NSS does not begin tracking user space usage until you create the first user quota on the volume. If you have never assigned a user quota to a volume, the All Users page has no information to report. After you create the first user quota on the volume, NSS begins tracking all of the user space used on the volume. From then on, the All Users page reports usage for all users with data on the volume.

The **Users with Quotas** report and **All Users** report include the following information:

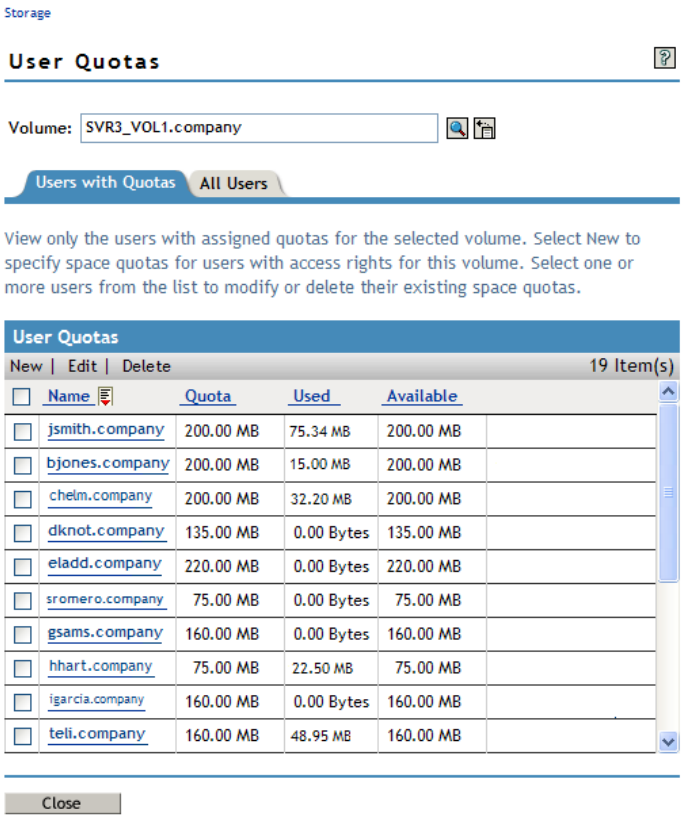
Table 23-1 *Report of User Space Quotas*

Parameter	Description
User Name	The distinguished user name. For example: userid.context, jsmith.geo.example, asantiago.example
Quota	Indicates the amount of space in MB that the user can use on the selected volume. The user's data can grow only to the size of the quota or to the amount of available physical space on the volume, whichever is less. NSS allocates space only as needed. You can set user quotas that total more than the total available space on the volume. This is called overbooking. However, you cannot set any single quota to be greater than the volume size.
Used	Reports the current amount of space used by the user's data in all directories combined on the specified volume. Reports the current amount of space used by the user's data in all directories combined on the specified volume.
Available	Reports the free, unused space within the user's quota for the specified volume. Because of overbooking, other users might be competing for a portion of this space.

Viewing User Quotas as the Administrator User

1. Log in to iManager as the Administrator user or equivalent user.
2. In iManager, click **Storage > User Quotas**.
3. Click the **Volume** browser, then select the volume that you want to manage.

   Wait for the page to refresh to see the user space restrictions for all users with quotas for the selected volume.


Storage
User Quotas
Volume: SVR3_VOL1.company
Users with Quotas
All Users
View only the users with assigned quotas for the selected volume. Select New to specify space quotas for users with access rights for this volume. Select one or more users from the list to modify or delete their existing space quotas.
User Quotas
New | Edit | Delete
19 Item(s)
Name
Quota
Used
Available
jsmith.company 200.00 MB 75.34 MB 200.00 MB
bjones.company 200.00 MB 15.00 MB 200.00 MB
chelm.company 200.00 MB 32.20 MB 200.00 MB
dknot.company 135.00 MB 0.00 Bytes 135.00 MB
eladd.company 220.00 MB 0.00 Bytes 220.00 MB
sromero.company 75.00 MB 0.00 Bytes 75.00 MB
gsams.company 160.00 MB 0.00 Bytes 160.00 MB
hhart.company 75.00 MB 22.50 MB 75.00 MB
igarcia.company 160.00 MB 0.00 Bytes 160.00 MB
teli.company 160.00 MB 48.95 MB 160.00 MB
Close

4 To view all users (with or without quotas) who have data stored on that volume, click **All Users**.

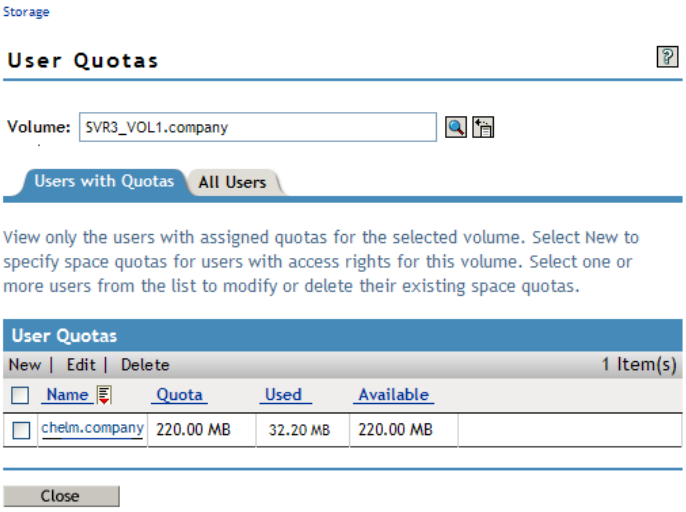
Viewing User Quotas as an Individual User

1 Log in to iManager as an individual user with your eDirectory username and password.

2 In iManager, click **Storage > User Quotas**.

3 Click the Volume browser, then select the volume that you want to manage.

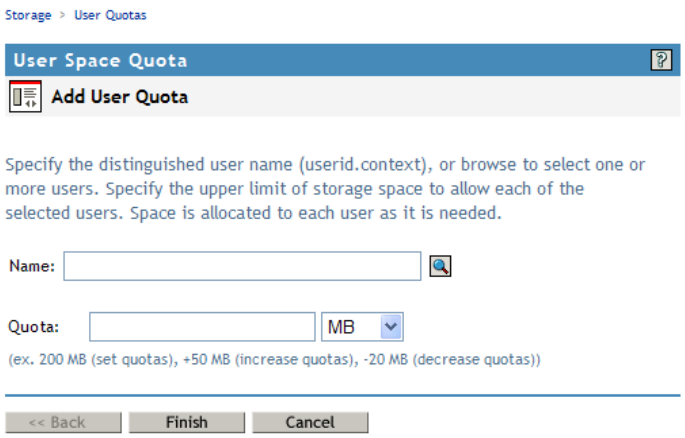
Wait for the page to refresh to see the individual user's space restrictions for the selected volume on the **Users with Quotas** page.


Storage
User Quotas
Volume: SVR3_VOL1.company
Users with Quotas
All Users
View only the users with assigned quotas for the selected volume. Select New to specify space quotas for users with access rights for this volume. Select one or more users from the list to modify or delete their existing space quotas.
User Quotas
New | Edit | Delete
1 Item(s)
Name
Quota
Used
Available
chelm.company 220.00 MB 32.20 MB 220.00 MB
Close

23.4.3 Configuring a User Space Quota

The Administrator user or equivalent user can configure the user space quota for one user or multiple users at a time.

1. In iManager, click **Storage > User Quotas**, then select the volume you want to manage.
2. Click **New** to open the **Add User Quota** dialog box.


Storage > User Quotas
User Space Quota
Add User Quota
Specify the distinguished user name (userid.context), or browse to select one or more users. Specify the upper limit of storage space to allow each of the selected users. Space is allocated to each user as it is needed.
Name:
Quota:
MB
(ex. 200 MB (set quotas), +50 MB (increase quotas), -20 MB (decrease quotas))
<< Back
Finish
Cancel

3. Click the **Browse** icon to open the User object list, then browse to select one or more users who you want to share the same quota.
4. In **User Quotas**, specify the upper limit of storage space that you want to assign to each of the selected users.
5. Use the **Units** drop-down list to select the units to use for the quota you specified in Step 4. Options are bytes, kilobytes, megabytes, gigabytes, terabytes, and petabytes.
6. Click **Finish** to apply the quota, or click **Cancel** to back out of the transaction.

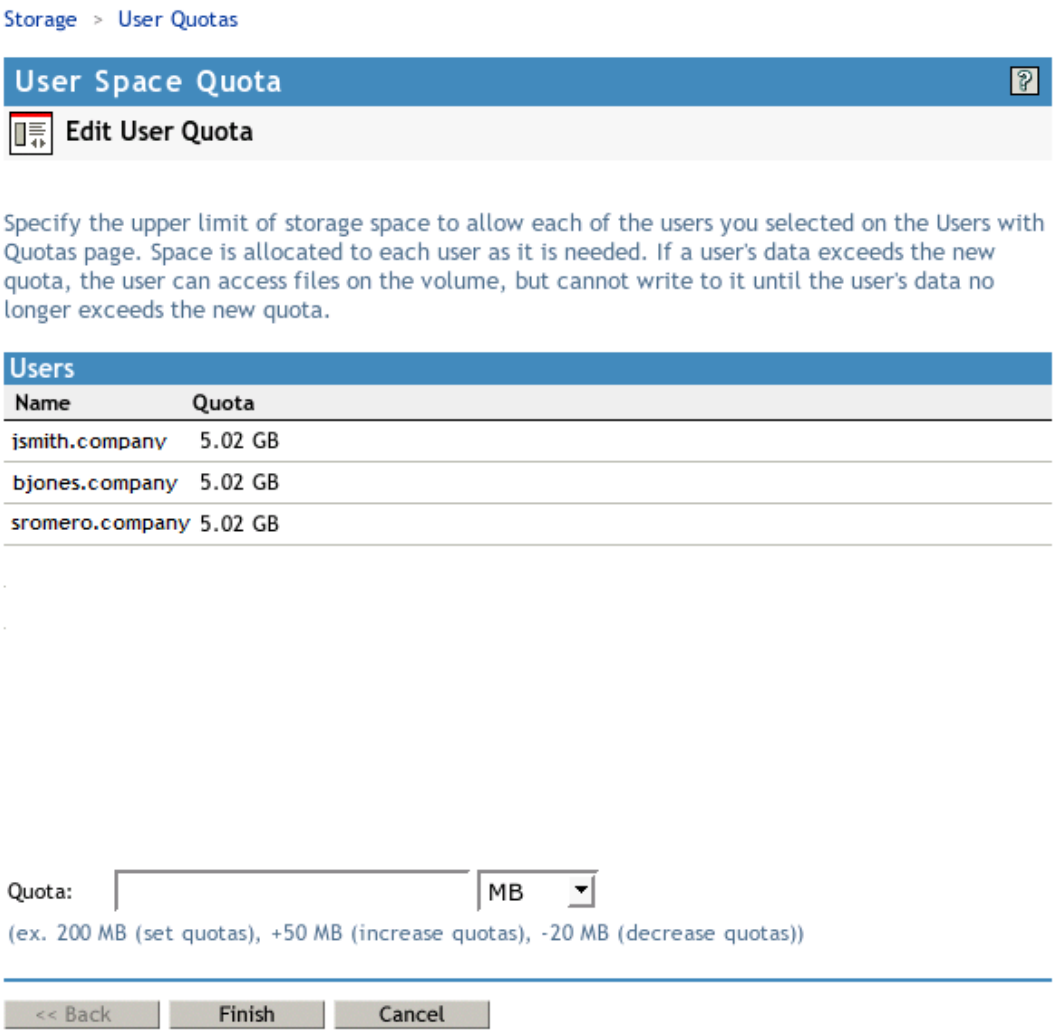
   Each of the usernames you selected now has user space quotas assigned to it.

23.4.4 Modifying a User Space Quota

The Administrator user or equivalent user can modify the quota for one user or multiple users at a time. Modify the current quotas for the selected users by setting a new quota for all users, increasing each quota by the same amount, or decreasing each quota by the same amount.

1. In iManager, click **Storage > Volumes**, select a server, then select the volume you want to manage.
2. Click **Quotas > Users with Quotas**.
3. Open the **Edit User Quotas** dialog box by doing one of the following:
   - **Single User:** Select the name link for the user.

- **Multiple Users:** Select the User check box next to one or more user names whose user space quota you want to delete, then click Edit.


Storage > User Quotas
User Space Quota
Edit User Quota
Specify the upper limit of storage space to allow each of the users you selected on the Users with Quotas page. Space is allocated to each user as it is needed. If a user's data exceeds the new quota, the user can access files on the volume, but cannot write to it until the user's data no longer exceeds the new quota.
Users
Name Quota
jsmith.company 5.02 GB
bjones.company 5.02 GB
sromero.company 5.02 GB
Quota:
MB
(ex. 200 MB (set quotas), +50 MB (increase quotas), -20 MB (decrease quotas))
<< Back
Finish
Cancel

4 Specify the change that you want to apply to each of the selected users by doing one of the following:

- **Modify Quota:** Specify a value to set each selected user's quota to the specified value, such as 200 MB.
- **Increase Quota:** Use a plus (+) with the value to increase each selected user's quota by that amount, such as +50 MB.

  If any individual quota or the total of all quotas exceeds the volume size, the increase is processed, because space is allocated to the users as needed, on a first-come-first-served basis.

  If you attempt to increase the quota for a user with an Unlimited quota, no changes are made for that user's quota. The setting remains Unlimited.
- **Decrease Quota:** Use a minus (-) with the value to decrease each selected user's quota by that amount, such as -20 MB.

If a reduction takes a user's quota to 0 MB, then the user is fully restricted. The user cannot add any new files no matter how many existing files are deleted. To remove the restriction, set a non-zero quota or delete the quota for the user.

If a reduction takes a user's quota to a negative value, then an error message reports the quota as an Invalid Quota. You must repeat the process to set a valid quota for the user.

5 Use the **Units** drop-down list to select the units to use for the quota you specified in Step 4. Options are bytes, kilobytes, megabytes, and gigabytes.

6 Click **Finish**.

Each of the users you selected now has the new user quota assigned to his or her individual account on this volume.

23.4.5 Deleting a User Space Quota

The Administrator user or equivalent user can delete the user space quota for one or more users. Deleting the user space quota for a user removes the space restriction for the user on the selected volume. Of course, any directory quotas or volume quotas still apply.

1 In iManager, click **Storage > User Quotas**, then select the volume you want to manage.

2 Select the **User** check box next to one or more user names whose user space quota you want to delete, then click **Delete**.

3 Do one of following:

- To confirm, click **Yes** to remove the quotas. The user accounts no longer have quotas assigned to them for the selected volume.
- To back out of the process, click **No**.

To remove all user space quotas on the volume at the same time, you can simply disable the User Space Quota attribute for the volume. For information about disabling the attribute, see Section 23.4.1, “Setting the User Space Quotas Attribute for an NSS Volume,” on page 344.

23.4.6 Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1

Beginning with OES 2, file ownership is properly assigned for access via the NCP protocol whether the user is Linux-enabled or not. User quotas for NCP users no longer require that a user be Linux-enabled.

For OES 1, using user space quotas required usernames to be Linux-enabled with Linux User Management (LUM). If an NCP user was not Linux-enabled on OES 1, any files the user created were assigned as the `root` user identity (after verifying the username's trustee rights to do so, of course) instead of the actual username.

If you migrate an NSS volume where NCP users were not Linux-enabled from OES 2 to OES 2015 or later, you will observe that the file ownership is now recorded as the actual user. However, existing files might still belong to the `root` user and are not counted against user space quotas.

IMPORTANT: Directories and files that were created while users were not Linux-enabled on the OES 2 server are owned by the `root` user and are not counted against the user space quotas you set unless you reassign file ownership to the individual users.

1. Use one of the following tools to change ownership of any files that the user normally uses that were previously assigned to the `root` user as owner:
   - Novell Client
   - Files and Folders plug-in to iManager

You cannot use the Linux `chown` command to change the creator field for the NSS file system. It changes the root user's view of who is reported as the owner user in the Linux path, but the change has no effect on the NSS metadata. The Linux `chown` command also does not modify the owner group.

24 Salvaging and Purging Deleted Volumes, Directories, and Files

This section describes how to configure the salvage system for OES Storage Services file systems on Open Enterprise Server.

- Section 24.1, “Understanding the NSS Salvage System,” on page 351
- Section 24.2, “Configuring the Purge Behavior for NSS,” on page 354
- Section 24.3, “Enabling or Disabling the Salvage Attribute for an NSS Volume,” on page 357
- Section 24.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 357
- Section 24.5, “Salvaging or Purging Deleted Files with iManager,” on page 359
- Section 24.6, “Salvaging or Purging Deleted Files with Other Tools,” on page 361

24.1 Understanding the NSS Salvage System

- Section 24.1.1, “Volume Salvage versus File Salvage,” on page 351
- Section 24.1.2, “Trustees and Rights Handling for Salvaged Data,” on page 353
- Section 24.1.3, “Understanding Purging Triggers,” on page 353

24.1.1 Volume Salvage versus File Salvage

The NSS salvage system makes it possible to retain deleted files for a specified period of time or until space is needed. The volume salvage and file salvage subsystems function separately.

For volume salvage, the NSS volumes are automatically retained on deletion. The deleted volume can be salvaged for a period of time that is determined by the server-level Logical Volume Purge Delay setting. Administrators with the Supervisor right can salvage or purge deleted volumes at any time before the purge delay elapses.

Table 24-1 describes parameters that control the volume salvage behavior for NSS volumes. The server-level settings apply to directories and files on all NSS volumes.

Table 24-1 *Volume Salvage Parameters*

Salvage Policy	Range of Influence	Refer to
Logical Volume Purge Delay	Server-level Default: 345600 seconds (4 days) The automatic purging delay applies to deleted NSS volumes.	Section 24.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 354

Salvage Policy	Range of Influence	Refer to
Logical Volume Purge Delay After Continue	Server-level Default: 900 seconds Seconds to delay purging a deleted volume after a continue.	Section 24.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 354
Logical Volume Purge Delay After Load	Server-level Default: 7200 seconds Seconds to delay purging a deleted volume after an NSS load if the purge delay elapses while NSS is disabled.	Section 24.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 354

Auto Purging of Logical Volumes: The auto purging of logical volumes is determined by all the above mentioned volume salvage parameters. For example, you have deleted a volume and set the following parameters for auto purging:

LogicalVolumePurgeDelay: 7:24:16 p.m.

LogicalVolumePurgeAfterContinue: 7:39:06 p.m.

LogicalVolumePurgeAfterLoad: 7:20:00 p.m.

The latest time is considered for auto purging. Therefore, the volume is purged at 7:39:06 p.m.

Salvage for directories and files is controlled by each volume’s Salvage attribute. You can enable the Salvage attribute when you create the volume, or modify the setting later in the volume’s properties. Deleted directories and files are retained and can be salvaged until space is needed in the pool where the volume resides, as determined by the pool’s available-space watermark settings. The administrator user or any user who is a trustee with the Create right can salvage deleted directories and files.

Table 24-2 describes parameters that control the file-system salvage behavior for NSS volumes.

Table 24-2 *Files Salvage Parameters*

Salvage Policy	Range of Influence	Refer to
Salvage attribute	Volume-level Default: Enabled	Section 24.3, "Enabling or Disabling the Salvage Attribute for an NSS Volume," on page 357
Immediate Purge of Deleted Files	Server-level Default: Disabled	Section 24.2.2, "Setting the Immediate Purge of Deleted Files for All NSS Volumes," on page 355
Low and High Watermarks	Pool-level Default: low 10%; high 20% Volume-level watermarks are not available.	Section 24.2.3, "Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files," on page 355
Purge Immediate file system attribute	Individual directory or file where the attribute is enabled.	Section 24.2.4, "Setting the Purge Immediate Attribute for a Directory or File," on page 357

24.1.2 Trustees and Rights Handling for Salvaged Data

When you salvage a volume, the data and metadata is exactly the same as it was at delete time, with no changes.When salvaging deleted directories or files, the content, trustees, trustee rights, and the inherited rights filters are just as they were before the file was deleted. If the rights in the tree above the salvaged file have changed, then the inherited rights for the salvaged deleted file are calculated based on the current rights above it in the directory tree.

24.1.3 Understanding Purging Triggers

Purging is triggered to begin by the following events. After the deleted data enters a Purge state by manually starting a purge or by autopurging, deleted files can no longer be salvaged (do not return to a Salvageable state), even if you pause the autopurging process.

- The Logical Volume Purge Delay setting times out for a deleted volume. Autopurging begins automatically and can take some time, depending on the size of the volume.

  The elapsed time between the delete and the purge is called the purge delay. The server-level LogicalVolumePurgeDelay parameter applies to all NSS volumes. For information, see Section 24.2.1, "Setting the Purge Delay for All Deleted Volumes," on page 354.
- The pool's Low Salvage Watermark setting is reached, indicating that the amount of free space is below the administrator-specified minimum. NSS automatically purges the deleted files and directories for all volumes in the pool with a first deleted, first purged policy until the free space reaches the high watermark, or until all of the existing deleted directories and files are purged, whichever occurs first.

You configure thresholds for space-based purging on each pool. Low and high watermarks determine when to begin and stop automatic purging of deleted files to free up space on the pool. For information, see Section 24.2.3, “Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files,” on page 355.

- A user or administrator purges the deleted file or directory.

  Deleted directories and files can be purged by the administrator user or by any user who is a trustee with the Erase right at any time before the automatic purge begins. For information, see Section 24.5.3, “Purging the Deleted Files,” on page 360.

- An administrator purges the deleted volume.

  Delete volumes can be purged by the administrator with Supervisor right to the volume. For information, see Section 24.5.3, “Purging the Deleted Files,” on page 360.

- Salvage is disabled at the server level for directories and files.

  Directories and files are purged immediately on deletion if the server-level ImmediatePurgeOfDeletedFiles parameter is enabled. If the Salvage attribute is enabled for a volume, this setting overrides it. For information, see Section 24.2.2, “Setting the Immediate Purge of Deleted Files for All NSS Volumes,” on page 355.

- Salvage is disabled for the individual directory or file.

  If the Salvage attribute is enabled for an NSS volume, you can set the PurgeImmediate file-system attribute on individual directories and files so that they are purged immediately on deletion. For information, see Section 24.2.4, “Setting the Purge Immediate Attribute for a Directory or File,” on page 357.

24.2 Configuring the Purge Behavior for NSS

- Section 24.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 354
- Section 24.2.2, “Setting the Immediate Purge of Deleted Files for All NSS Volumes,” on page 355
- Section 24.2.3, “Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files,” on page 355
- Section 24.2.4, “Setting the Purge Immediate Attribute for a Directory or File,” on page 357

24.2.1 Setting the Purge Delay for All Deleted Volumes

The Purge Delay setting for the NSS volume determines the amount of time (in seconds) that you can still access the deleted volume before it is removed from the system. The default value for the Purge Delay setting is 345600 seconds (4 days). The volume name is changed during delete so that a new volume with the same name can be immediately created. The management tool used to delete the volume should clean up any NetIQ eDirectory Storage objects at delete time. Use NSSMU or the Storage plug-in to iManager to purge or salvage the deleted volume before the Purge Delay time elapses.

To configure the Purge Delay time, issue the following command at the NSS Console (`nsscon`) as the `root` user:

```
nss /LogicalVolumePurgeDelay=value
```

In this command, replace *value* with the actual number of seconds to delay the purge. For example, if you want to change the Purge Delay time from the default of 4 days to 1 day, set the value to 86400 by entering:

```
nss /LogicalVolumePurgeDelay=86400
```

The Purge Delay change command is not permanent when entered from the command line. You must enter the command each time you restart the server. To make the new setting permanent, add the command to the `/etc/opt/novell/nss/nssstart.cfg` file.

24.2.2 Setting the Immediate Purge of Deleted Files for All NSS Volumes

The salvage capability for directories and files can be turned on and off for NSS at the server level by using the /(No)ImmediatePurgeOfDeletedFiles flag. By default, the setting is disabled (set to NoImmediatePurgeOfDeletedFiles). You might want to enable this setting if you have Salvage enabled for multiple volumes, but want to disable salvage across all of them without separately changing the volumes' Salvage attribute settings.

This server-level salvage setting overrides the settings for the volume-level Salvage attribute. It does not affect deleted NSS volumes. Issue the commands at the NSS Console (`nsscon`) as the `root` user

Table 24-3 *Server-Level Salvage Parameter*

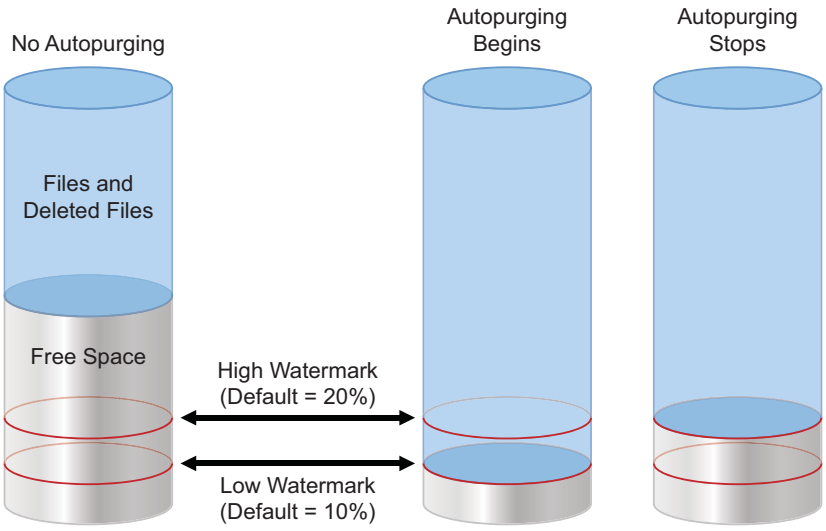
Parameter	Description
`nss /NoImmediatePurgeOfDeletedFiles`	**Supported Values:** Enabled or disabled (default)
`nss /ImmediatePurgeOfDeletedFiles`	If this parameter is enabled, it overrides the Salvage attribute setting for individual NSS volumes so that the directories and files are immediately purged on deletion.

24.2.3 Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files

Salvage watermarks are parameters associated with the salvage feature of NSS pools. Automatic purging of deleted files begins when the pool's low watermark is reached and continues until its high watermark is reached, or until all existing deleted files and directories have been purged. Files and directories are purged on a first-deleted, first-purged bases. If you have a deleted volume in the pool, the deleted volume along with any deleted files and directories that existed when the volume was deleted are not considered for this space-based purge.

When free space in the pool falls below a low watermark, NSS begins autopurging the deleted files. When enough files are purged so that the free space increases to a percentage equal to or greater than the high watermark, the autopurge stops. The autopurge also stops before the high watermark is reached if there are no more deleted files or directories to be purged. Autopurging does not start again until free space again drops below the low watermark.

Figure 24-1 *How Autopurging Works*



The high and low watermarks can be configured only at a pool level. The default low watermark is 10% of the maximum pool size. The default high watermark is 20% of the maximum pool size. The low watermark's percentage can range from a minimum of 0% to a maximum of 98%. The high watermark's percentage can range from a minimum 2% to a maximum of 100%. The high and low watermarks must be at least 2% apart from each other.

IMPORTANT: The pool's watermark settings are enforced only at the pool level. Volume-level watermarks are not supported. The Storage plug-in to iManager displays default values for volume watermarks, but they have no effect. In order for a volume to benefit from the watermark protection, set the volume's size to grow to the size of the pool.

At the minimum setting of 0%, the low watermark activates the autopurge only when the pool is totally out of free space. If the watermark is set this low, users are likely to get out-of-space errors when they try to save files. Setting the low watermark to a percentage a little higher than 0% guarantees that autopurging begins before free space is completely used, and users are less likely to get out-of-space errors.

The low and high salvage watermarks for a pool are set on boot to the default levels. Commands to modify the watermarks can be issued from the command line or placed in a startup file. Settings in the startup file persist across server reboots. Commands issued at the command line persist until the next reboot, or until the command is issued again, whichever occurs first.

Use the following commands to configure the high and low watermarks for pools. Issue the commands in the NSS Console (`nsscon`) as the `root` user.

`nss /PoolHighWaterMark=`*`poolname`*`:Percent/MB/GB`

`nss /PoolLowWaterMark=`*`poolname`*`:Percent/MB/GB`

Replace the *poolname* with the name of an individual pool or with All to set the value for all pools. For example, to set the low watermark to 5% and the high watermark to 10% for pool `p_users`, enter

```
nss /PoolHighWaterMark=p_users:10%/MB/GB
```

```
nss /PoolLowWaterMark=p_users:5%/MB/GB
```

24.2.4 Setting the Purge Immediate Attribute for a Directory or File

The Purge Immediate file-system attribute flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered. When this attribute is enabled, it overrides the salvage settings at the volume and server level. When it is disabled, the server and volume salvage settings apply. In order to modify this setting, you must be the administrator user or a user who is a trustee with the Erase right.

1. In iManager, select **Files and Folders > Properties**.
2. Click the **Search** icon to locate and select the directory or file you want to manage.
3. Click the **Information** tab to view the properties for the selected directory or file.
4. Scroll down to view the **Attributes** section, then select the **Purge Immediate** attribute to enable the selected directory or file to be purged immediately on deletion, or deselect it to allow the salvage settings to control the fate of the deleted directory or file.
5. Click **Apply** or **OK** to save your changes.

24.3 Enabling or Disabling the Salvage Attribute for an NSS Volume

You can enable the Salvage attribute when you create the volume, or modify the setting later in the volume's properties.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.
3. In the **Volumes** list, select a volume that you want manage.
4. Click **Properties**.

   The Properties page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. Use the Attributes page to view or modify the attributes for the selected volume.
5. Select (enable) or deselect (disable) the Salvage attribute, then click **Apply**.

24.4 Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool

If you delete a volume, NSS removes it from the pool. During the Purge Delay (by default, four days after a volume is deleted), you can manually purge deleted volumes, view the volume contents, transfer files from the deleted volume to other volumes, or salvage the entire volume. When you salvage a volume, the data and metadata are exactly the same as they was at delete time, with no changes. After the Purge Delay time elapses, NSS automatically purges the deleted volume from the system and you can no longer access it. You can also manually purge any volumes you have deleted.

WARNING: If you delete an entire pool, all the volumes are deleted with it. You cannot restore a deleted pool or any deleted volumes in it.

You can change the Purge Delay time to extend or reduce the time for the automatic purging cycle. For information, see Section 24.2.2, "Setting the Immediate Purge of Deleted Files for All NSS Volumes," on page 355.

The **Deleted Volumes** option on the Pools page opens a separate Deleted Volumes page where you can purge or salvage the deleted volumes for the pool. This option is only available if the selected pool has deleted volumes on it.

To manage the deleted volumes in a pool:

1. In iManager, click **Storage > Pools**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.

2. Select a server to manage.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.

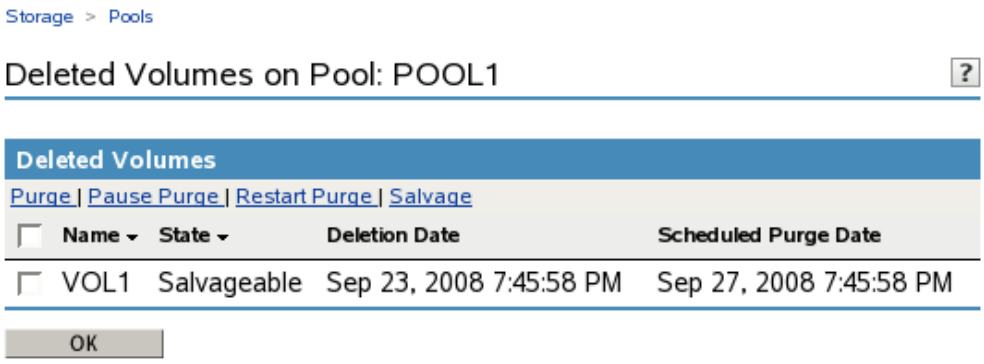
   A list of pools appears in the **Pools** list.

3. Select the pool that you want to manage.

   Wait for the page to refresh and display the details. The **Deleted Volumes** button is active only when there are deleted volumes in that list.

4. If the button is available, click **Deleted Volumes**.

   This opens the Deleted Volumes page.



5. Select a volume from the **Deleted Volumes** list.

   The browser refreshes to display details in the **Details** area.

   - **Pool:** The pool name.
   - **Volume Was Deleted:** The time stamp when the volume was deleted.
   - **Scheduled Purge Time:** The time that the Purge Delay expires for this deleted volume and the purging process is scheduled to begin.
   - **Current Deletion State:** The deletion states are salvageable, purging, or paused.

6 Select one or more volumes, then perform one or more of these actions:

- **Purge:** Immediately begins the process of purging the selected volumes and their contents. After this option is selected, the deleted volume can no longer be salvaged (does not return to a Salvageable state). You cannot stop the purging by clicking **Pause Purge** for the autopurging process; the two options are unrelated.
- **Pause Purge/Restart Purge:** **Pause Purge** disables autopurging for the selected volumes so that purging does not begin automatically for a deleted volume when its Purge Delay time elapses. During the purge delay or while autopurging is disabled, the deleted volume is salvageable.

  Restart Purge enables autopurging for the selected volumes. The deleted volume is purged when the purge delay time elapses.

  This option does not make it possible to salvage a deleted volume that has already entered a Purge state.
- **Salvage:** Begins the restore process for deleted volumes you selected.

  If you salvage a volume, you can assign a new name to that volume, or reuse the old one if no current volume is using that name. A wizard opens to allow you to name the salvaged volume.

  The volume salvage process can slow the server response time, so you might want to do this when there is less server activity.
- **Close:** Closes the Deleted Volumes page.

24.5 Salvaging or Purging Deleted Files with iManager

As an administrator, you can use the Files and Folders plug-in to iManager to salvage or purge deleted files from an NSS volume where the Salvage attribute is enabled. When salvaging deleted files, the file content, trustees, trustee rights, and inherited rights filter are just as they were before the file was deleted. If the rights in the tree above the salvaged file have changed, then the inherited rights for the salvaged deleted file are calculated based on the current rights above it in the directory tree.

- Section 24.5.1, “Prerequisites,” on page 359
- Section 24.5.2, “Salvaging the Deleted Files,” on page 360
- Section 24.5.3, “Purging the Deleted Files,” on page 360

24.5.1 Prerequisites

- The NSS volume that you want to manage must be in the same tree where you are currently logged in.
- You must have trustee rights for the file that you want to manage.
- The NSS volume must be configured for salvage at the time the files, directories, or volumes are deleted in order for deleted files to be available. Enable the Salvage attribute by going to the volume’s Attributes page (**Storage > Volumes > Properties > Attributes**), select **Salvage**, then click **OK**.
- Deleted files are typically purged according to the Purge Delay settings set in NSS. When the delay time elapses, the deleted data is no longer available for salvage.

- Deleted files can be salvaged by any trustee for the file with the Create right. If another user has purged the deleted file, it is no longer available for salvage.
- Deleted files can be purged by any trustee for the file with the Erase right. If another user has purged the deleted file, it is no longer available for salvage.
- If the Purge Immediate attribute is set for a file or folder, the file or folder is immediately and permanently removed from the volume upon deletion.

24.5.2 Salvaging the Deleted Files

You can salvage a deleted file and restore it to the directory from which it was deleted if you are a trustee of the file with the Create write. You can choose to overwrite any existing copies of the file in that location, or to rename the deleted file before it is salvaged. Review the guidelines in Section 24.5.1, “Prerequisites,” on page 359 to understand when deleted files are available for salvage.

1. In iManager, click **Files and Folders**, then click **Deleted Files** to open the Deleted File page.
2. On the Deleted File page, use one of the following methods to locate the folder on an NSS volume where the deleted file existed when it was deleted:
   - Click the **Search** icon to browse and locate the folder, then click the name link of the folder to select it.
   - Click the **History** icon to select a folder from the list of folders that you recently accessed.

   The **Deleted Files** report lists the deleted files in the folder and shows who deleted each file and when it was deleted.
3. Browse the list of deleted files to locate the version of the file you want to salvage.
4. Select one or more deleted files that you want to salvage, then click **Salvage**.

   NOTE: To successfully salvage files, it is mandatory that the parent folders of the files that you intend to salvage exist. If they do no exist, salvage the parent folders first.
5. While salvaging, if a file already exists with the same name as the salvaged file, an error message is displayed. To rename the salvaged file or overwrite the existing file with the salvaged file, use OES File Access Rights Management (NFARM) utility.

24.5.3 Purging the Deleted Files

You can purge a deleted file to remove it immediately from the volume if you are a trustee of the file with the Erase right. Purged files can no longer be salvaged. Review the guidelines in Section 24.5.1, “Prerequisites,” on page 359 to understand when deleted files are available for purging.

1. In iManager, click **Files and Folders**, then click **Deleted File** to open the Deleted File page.
2. On the Deleted File page, use one of the following methods to locate the folder on an NSS volume where the deleted file existed when it was deleted:
   - Click the **Search** icon to browse and locate the folder, then click the name link of the folder to select it.
   - Click the **History** icon to select a folder from the list of folders that you recently accessed.

   The **Deleted Files** report lists the deleted files in the folder and shows who deleted each file and when it was deleted.

3 Browse the list of deleted files to locate the version of the file you want to purge.

4 Select one or more deleted files that you want to purge, then click **Purge**.

24.6 Salvaging or Purging Deleted Files with Other Tools

You can use any of the following methods to salvage or purge deleted files. To purge, the user must be a trustee of the file with the Erase right. To salvage, the user must be a trustee of the file with the Create right.

- Section 24.6.1, “Using NetStorage,” on page 361
- Section 24.6.2, “Using the Client for Open Enterprise Server,” on page 361
- Section 24.6.3, “Using NFARM,” on page 362

24.6.1 Using NetStorage

Using NetStorage, the Administrator user, the Admin-equivalent user, and individual users can purge and possibly undelete NSS files that were previously deleted on the server.

1 Access NetStorage.

For information, see Section 10.4, “OES NetStorage,” on page 117.

2 In the left column, select the directory where the deleted files were located when they were deleted.

3 Click **View**, then click **Show Deleted Files**.

4 Select the check box next to one or more files you want to undelete or purge.

5 Click **File**, then click **Undelete** or click **Purge**.

24.6.2 Using the Client for Open Enterprise Server

Using the Client for Open Enterprise Server for Windows 2000/XP/2003, Administrator users, Admin-equivalent users, and individual users can purge and possibly undelete NSS files that were previously deleted on the server.

1 Right-click the Client for Open Enterprise Server icon in the notification area to display the menu.

2 If you want to salvage a deleted file, click **Novell Utilities > Salvage** (or **NetWare Utilities > Salvage** on older client versions), browse to locate the directory where the deleted file resided, then do one of the following:

- To restore one or more deleted files, select the deleted files, then click **Salvage File**.
- To restore all deleted files in the directory, click **Salvage All**.

3 When you are done, click **OK**.

4 If you want to purge a deleted file, click **Novell Utilities > Purge** (or **NetWare Utilities > Purge** on older client versions), browse to locate the directory where the deleted file resided, then do one of the following:

- To purge one or more deleted files, select the deleted files, then click **Purge File**.

- To purge all deleted files in the directory, click **Purge All**.
- To purge the directory's subdirectories and all deleted files in them, click **Purge Subdirectories**.

5 When you are done, click **OK**.

You can also purge deleted files from NCPCON using the command `purge volume`. For more information, see "Using NCPCON to Purge Deleted Files" in the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

24.6.3 Using NFARM

This section includes the following:

- "NFARM Installer for Windows" on page 362
- "NFARM Installer for Mac" on page 362

NFARM Installer for Windows

For information on salvaging and purging the deleted files on Windows using NFARM, see Salvage and Purge on Windows in the OES 2018 SP3: OES CIFS for Linux Administration Guide.

NFARM Installer for Mac

For information on salvaging and purging the deleted files on Mac using NFARM, see Salvage and Purge on Mac in the OES 2018 SP3: OES CIFS for Linux Administration Guide.

25 Managing Hard Links

This section describes how to configure, create, and delete hard links on OES Storage Services volumes on Open Enterprise Server server.

- Section 25.1, “Understanding Hard Links,” on page 363
- Section 25.2, “Upgrading the Media Format for Hard Links Support,” on page 367
- Section 25.3, “Enabling or Disabling the Hard Links Attribute,” on page 368
- Section 25.4, “Creating a Hard Link Using Ln on an NSS Volume,” on page 369
- Section 25.5, “Creating a Hard Link Using a zLink API,” on page 370
- Section 25.6, “Creating a Hard Link for Testing Purposes,” on page 370
- Section 25.7, “Viewing Hard Links for a File,” on page 371
- Section 25.8, “Deleting a Hard Link,” on page 372
- Section 25.9, “Deleting a Primary Link,” on page 372

25.1 Understanding Hard Links

OES Storage Services supports zero to 65,535 hard links per file on NSS volumes. Hard link support for an NSS volume allows users to create multiple names for a single, existing file object in the same directory or in multiple directories in the same NSS volume.

IMPORTANT: Hard links to directories, data streams, and extended attributes are not allowed.

The alternate names for the file object link to the primary file inode in the NSS file system. One file can have different filenames in the same directory or multiple directories as long as all of the directories reside on the same volume. It is not possible to create hard links from different volumes and have them point to the same file.

This section describes the following:

- Section 25.1.1, “Hard Links and the Primary Link,” on page 364
- Section 25.1.2, “Hard Links and Linux Users,” on page 364
- Section 25.1.3, “Hard Links and File Ownership,” on page 364
- Section 25.1.4, “Hard Links and File System Trustees,” on page 365
- Section 25.1.5, “Hard Links and Directory Space Quotas,” on page 365
- Section 25.1.6, “Hard Links and User Space Quotas,” on page 366
- Section 25.1.7, “Hard Links and the Hard Links Attribute,” on page 366
- Section 25.1.8, “Hard Links and File Salvage and Purge,” on page 366
- Section 25.1.9, “Hard Links and DFS Move Volume,” on page 366

25.1.1 Hard Links and the Primary Link

Every file has what is considered to be the primary link, which is originally the path and filename assigned at file creation time. The primary parent directory is originally the path and directory name where the file is created. When you create hard links for the file, the file's primary link and all of its hard links share the file content by pointing to the file's inode. All links share all of the file's metadata except for name information; each link accesses only its own filename information.

When multiple hard links exist for a file, you can delete the file's primary link or its hard links, but the file's content and metadata are not deleted until the last remaining link is deleted. If you delete a hard link, the link name is deleted, not the file. If hard links exist, whenever you delete a primary link, the most recently created hard link automatically becomes the new primary link.

When the primary link is deleted and the status of primary is given to the next hard link, the following occurs:

- The file owner does not change.
- The explicitly assigned file system trustee assignments, trustee rights, and file attributes for the file do not change.
- If the new primary link is in a different directory, the file's inherited rights filter applies to the new parent directory, so effective rights for the file's trustees can change. For information, see Section 25.1.4, "Hard Links and File System Trustees," on page 365.

  IMPORTANT: Make sure to check the consequences to effective rights before deleting the primary link.

- For the directory space quota, the total disk space used by the file is reassigned from the old primary link's parent directory to the new primary link's parent directory. For information, see Section 25.1.5, "Hard Links and Directory Space Quotas," on page 365.
- For the user space quota, the total disk space used by the file continues to be associated with the file's assigned owner.

25.1.2 Hard Links and Linux Users

When hard links are used on NSS volumes, users must be Linux-enabled eDirectory users.

25.1.3 Hard Links and File Ownership

In the NSS file system, the user who creates a file is assigned as its owner at file creation time. File ownership is not affected by transferring the primary link, creating hard links, or deleting hard links. A file can have only one owner, even if has multiple hard links.

File ownership rarely, if ever, changes, but an administrator or administrator equivalent user can assign a new owner when necessary. Changing file ownership requires the Supervisor right for the primary parent directory and the file. Use whatever tools you normally use to modify the file's ownership.

NSS uses the OES trustee model to secure access to the file, not file ownership. For information about how access control is affected by hard links, see Section 25.1.4, "Hard Links and File System Trustees," on page 365.

File ownership allows accounting of disk block usage per user and enables user space quotas to operate effectively. For information, see Section 25.1.6, “Hard Links and User Space Quotas,” on page 366.

File ownership has no affect on the directory space quotas. For information, see Section 25.1.5, “Hard Links and Directory Space Quotas,” on page 365.

25.1.4 Hard Links and File System Trustees

Explicit file system trustee assignments, trustee rights, and attributes for a file are stored in the file’s metadata where the information is shared equally by the primary link and all hard links. For users who match the trustee, the file is visible along any path of the file’s primary link and hard links. Explicit access security is enforced equally for any of these paths.

Inherited trustee assignments and trustee rights are inherited only through the primary link’s parent directory. When calculating effective rights to a file, rights are granted based on explicit rights and rights inherited from the primary link’s parent directory path.

If the primary link is deleted and reassigned, the inheritance changes to the settings of the newly assigned primary link’s parent directory.

NOTE: For information about how the hardlinks on an NCP volume work with file ownership and trustees, see Hard Links in the OES 2018 SP3: NCP Server for Linux Administration Guide.

IMPORTANT: Make sure you verify the effective rights on the new primary link whenever you delete a primary link.

25.1.5 Hard Links and Directory Space Quotas

If you set a directory space quota for a file’s primary parent directory, the file’s size is charged against the quota. All metadata increases associated with hard links are included in the file’s total disk space usage. For hard links in the primary parent directory, the file has an alternate name, but the charge for space usage is not duplicated. For hard links in other directories, quotas for their parent directories are not charged for space usage.

Whenever you delete a primary link, the most recently created hard link automatically becomes the new primary link. At that time, the file’s size is subtracted from the space usage reported on an old primary link’s parent directory and added to the space usage reported on the newly assigned primary link’s parent directory. The file’s space usage is no longer charged against the directory space quota on the old directory. If a quota is set on the new primary link’s parent directory, the file’s space usage is charged against it.

When you delete a primary link, the transfer of responsibility for space usage to the new primary parent directory is allowed even if the added file size overbooks its directory space quota. NSS allows the quota to be overbooked, and then enforces the directory quota restrictions.

IMPORTANT: Make sure you verify the directory quota on the new primary link’s parent directory whenever you delete a primary link.

25.1.6 Hard Links and User Space Quotas

User space restrictions are charged based on ownership of the file. Ownership is tracked with the user's GUID, not the username. If the username ever becomes invalid, the file continues to be charged to the GUID. In a space usage report, the value of the GUID appears in place of where the a valid username would normally be.

If other users create hard links to the file, they are not charged a quota on that file. The file size is charged to the file owner's user space quota, even if the owner no longer has the necessary rights to access the file. If hard links exist, deleting the primary link does not delete the file, and the owner continues to be responsible for the space used.

The file's users can delete the primary link and hard links to the file only in directories where they have the necessary access rights. Hard links from directories the owner cannot access causes the file to be retained, and the owner continues to be charged for its quota. The file continues to be charged against the owner's user space quota until the file itself is deleted or until the system administrator reassigns another user as the file owner.

When file ownership is changed, the new owner's user space quota is checked before the change of ownership is allowed. If the file size will overbook the user space quota, the change is not allowed.

IMPORTANT: Make sure you verify the user space quota on the new owner whenever you change ownership of a file.

25.1.7 Hard Links and the Hard Links Attribute

Hard links support is available on OES 2 and later.

A media upgrade is required. For instructions, see Chapter 5, "Upgrading the NSS Media Format," on page 51.

The hard links attribute for the NSS volume must be enabled to allow hard links to be created. For information, see Section 25.3, "Enabling or Disabling the Hard Links Attribute," on page 368.

25.1.8 Hard Links and File Salvage and Purge

The interaction between hard links and the salvage system depends on how many links exist for a specified file. If a file has multiple links pointing to it, and one of the links is deleted, the hard link name is not added to the salvage system, and cannot be recovered later via a salvage operation. When the last and only remaining link to a file is deleted, that last name is a candidate for the salvage system. If the Salvage Files attribute is enabled on the volume, and an immediate purge is not in force, then the last link to be deleted is added into the salvage system. Under this final primary link and filename, the file can be salvaged or purged until the file is autopurged from the system.

25.1.9 Hard Links and DFS Move Volume

If you use the OES Distributed File Services Volume Move operation to move a volume that has been upgraded to the new media format for hard links, consider the following guidelines:

- Before you create the DFS Move Volume job, make sure that NSS is set so that the new target volume is automatically created with the upgraded media format for enhanced hard links.

- If you moved the volume without enabling the new media format, you must upgrade the volume to the new media format after the move completes successfully.
- In the initial release of OES 2, the Move Volume Wizard does not have an option to enable the Hard Links attribute for the new target volume. After the move is completed and the media format is upgraded for enhanced hard links support, you must manually enable the Hard Links attribute. For instructions, see Section 25.3, "Enabling or Disabling the Hard Links Attribute," on page 368.

25.2 Upgrading the Media Format for Hard Links Support

An enhanced NSS media format is available that provides improved support for hard links. After you install or upgrade your operating system to Open Enterprise Server 2, you can decide whether to upgrade the media format for your NSS volumes to use the new metadata structure; some restrictions apply. For information, see Section 5.1, "Guidelines for Upgrading the Media Format of NSS Volumes," on page 51.

25.2.1 New Metadata Structure Supports Up to 65,535 Hard Links for a File

NSS volumes can support up to 65,535 hard links for a file, regardless of the length of the filename and the number of name spaces used. To use hard links on these operating systems, you must upgrade the NSS volume to use a new metadata structure.

25.2.2 Old Metadata Structure Supports Limited Hard Links for a File

Previously, NSS volumes support only a limited number of hard links for a file. These volumes use a metadata structure that provides limited space for the file's filenames across all name spaces.

With the old metadata structure, the number of hard links you can use for a file depends on the length of the names you choose for a file, and how those names can be shared across the UNIX, Long, DOS, and Macintosh name spaces. It is also limited by the amount of space available in the metadata structure.

IMPORTANT: The sum total of all metadata for a file cannot exceed 2 KB. In the old metadata structure, this includes all hard link names. The longer the names are, the fewer hard links you can create.

If you reach the 2 KB metadata limit, you cannot create new hard links until you make room for them. Use any of the following methods:

- Delete one or more hard links for the file.
- Create hard links for the file with shorter names that can be stored optimally in each name space.
- Rename the original file with a shorter name that can be stored optimally in each name space.

25.3 Enabling or Disabling the Hard Links Attribute

The new media format for enhanced hard link support provides the Hard Links attribute for NSS volumes. The Hard Links attribute must be enabled in order to create and manage hard links on an NSS volume.

When you upgrade the NSS volume to use the new media format, if any old-style hard links are detected, the Hard Links attribute is automatically enabled. Otherwise, the volume is upgraded, but the Hard Links attribute is disabled. The attribute must be enabled before you can create hard links.

- Section 25.3.1, “Prerequisite,” on page 368
- Section 25.3.2, “Hard Links Attribute Commands,” on page 368
- Section 25.3.3, “Viewing the Hard Link Attribute Setting,” on page 369

25.3.1 Prerequisite

The NSS volume must be upgraded to the new media format for enhanced hard link support. For instructions, see Chapter 5, “Upgrading the NSS Media Format,” on page 51.

25.3.2 Hard Links Attribute Commands

Use the commands in this section to enable or disable the Hard Links attribute for an NSS volume. The Hard Links attribute cannot be set or viewed in NSSMU or in the Storage plug-in to iManager.

Issue the commands at the NSS Console (`nsscon`) as the `root` user.

`nss /HardLinks=`*`volumename`*

Enables the Hard Links attribute for the specified volume. This enables hard links to be created on the volume.

`nss /HardLinks=all`

Sets the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

`nss /NoHardLinks=`*`volumename`*

Disables the Hard Links attribute for the specified volume. Existing hard links continue to function, but no new hard links can be created on the specified volume.

`nss /NoHardLinks=all`

Disables the Hard Links attribute for all NSS volumes on the server. Existing hard links continue to function, but no new hard links can be created on any NSS volume on the server.

25.3.3 Viewing the Hard Link Attribute Setting

The Hard Links attribute cannot be viewed in NSSMU or in the Storage plug-in to iManager. Use the `nss /volumes` command to determine whether the Hard Links attribute is set for the NSS volume. In the **Attributes** column, the Hard Links attribute is listed if the attribute is enabled.

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter the following to start the NSS Console:

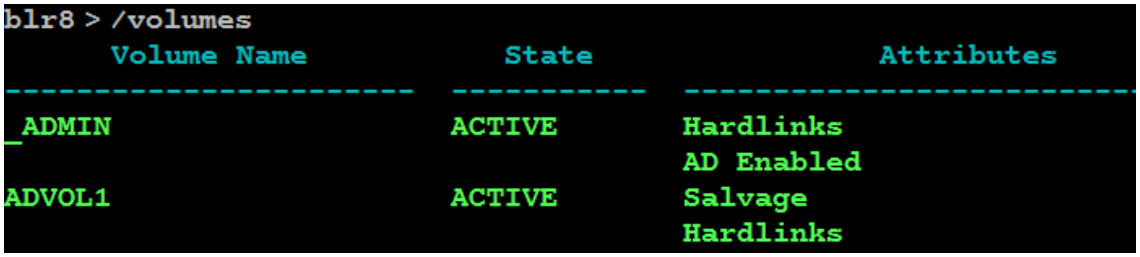
   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter either of the following commands:

   ```
   nss /volumes
   ```

   ```
   volumes
   ```

   In the **Attributes** column, the Hard Links attribute is listed if the attribute is enabled.



25.4 Creating a Hard Link Using Ln on an NSS Volume

Typically, you create hard links by using clients (like NFS) that have existing commands to manipulate links. This section explains how to create a hard link in a volume by mounting the volume with NFS, then using the Link (`ln`) command to create a hard link. For help with syntax and options, refer to the Link Manual Page from a Linux client. At a terminal console, enter

```
man ln
```

Creating a hard link to a file does not copy the contents of the file to the new location; it simply makes a new name by which the file can be known, in addition to the file's existing name or names. All of the names are equally real, and no one of them is preferred to the others except regarding access control and directory space quotas. For information, see Section 25.1, "Understanding Hard Links," on page 363.

The actual content of the file is maintained in only the original file. Users in different directories can use hard links to access and share the same file. A single user can use hard links to access a file from different directories.

Prerequisites

- The NSS volume must be upgraded to use the new metadata structure. For information, see "Upgrading the NSS Media Format" on page 51.

- The Hard Links attribute must be enabled for the volume. For information, see Section 25.3, "Enabling or Disabling the Hard Links Attribute," on page 368.
- Mount the volume with NFS.

Procedure

To create a hard link, use the Link (`ln`) command from a Linux client.

1 At a terminal console, enter

```
ln /path/filename /linkpath/linkfilename
```

Replace */path/filename* with the pathname for the original file. Replace */linkpath/linkfilename* with the pathname for the hard linked filename.

For example, to link the file `/tmp/timetest` to `/tmp/t1`, enter

```
ln /media/nss/VOL1/timetest /media/nss/VOL1/t1
```

The file can now be referred to by either name. You can delete the original name or any link name, but the contents of the file are not removed until the final name is deleted.

25.5 Creating a Hard Link Using a zLink API

To create a hard link from an application or script, you can use a zLink API. For information, see the *NDK: File System Services (64-bit)* (http://developer.novell.com/ndk/doc/fs64/fs64_enu/data/a5p4x94.html).

You can also use the Linux `link(2)` command to create hard links from applications or scripts.

25.6 Creating a Hard Link for Testing Purposes

While working on a server, you can use the `nss /CreateHardLink` command to create hard links for testing purposes only. In a production environment, use the Link (`ln`) command from a client instead, as described in Section 25.4, "Creating a Hard Link Using Ln on an NSS Volume," on page 369.

IMPORTANT: Do not use the `nss /CreateHardLink` command in a production environment.

- Section 25.6.1, "Prerequisites," on page 370
- Section 25.6.2, "Procedure," on page 371

25.6.1 Prerequisites

- The NSS volume must be upgraded to use the new metadata structure. For information, see "Upgrading the NSS Media Format" on page 51.
- The Hard Links attribute must be enabled for the volume. For information, see Section 25.3, "Enabling or Disabling the Hard Links Attribute," on page 368.
- Hard links must be created on the same volume as the original file.

25.6.2 Procedure

To create a hard link for testing purposes on your server:

1 Issue the command at the NSS Console (`nsscon`) as the `root` user.

`nss /CreateHardLink=`*`PrimaryFilePath`*`|`*`HardLinkFilePath`*

Replace *`PrimaryFilePath`* with the complete volume name, pathname, and filename of the primary file. Replace *`HardLinkFilePath`* with the complete volume name, pathname, and filename of the new hard link.

IMPORTANT: The file paths are specified using the Long name space.

For example, to create a hard link on a volume named VOL1:

`nss /CreateHardLink=VOL1:\`*`path`*`\`*`file.ext`*`|VOL1:\`*`newpath`*`\`*`newfile.ext`*

25.7 Viewing Hard Links for a File

You can view a report of hard links for a file to identify its primary link and the hard link that becomes the primary link if the primary link is deleted. The `nss /ListHardLinks` command returns a list of all hard links for a specified file, where the first link in the list is the primary link. The second link is the most recently created hard link. All other hard links follow in reverse chronological order of their create time. All links for the file are listed in the order that they appear in the metadata, which is also the order in which a new primary name would be assigned.

IMPORTANT: If the primary link is deleted, the most recently created hard link (the second link reported in the list) becomes the new primary link. Changing the primary link can impact the trustees and inheritance for the file. For more information, see Section 25.1.4, “Hard Links and File System Trustees,” on page 365.

The list of hard links contains the following information for the file:

List of Hard Links	Information
Line 1 of the report	The ZID (file number) of the inode that contains the metadata for the hard link file set and the number of links associated with that inode.
Line 2 of the report	The complete name of the primary link, including the path and filename
Line 3 of the report	The complete name of the most recently created hard link name, including the path and filename. This is the next candidate in line to become the primary link if the primary link is deleted.
Lines 4 through 65,536 (up to 65,535 links per file) of the report	The complete name of each of the hard link names, including the path and filename, are listed in the reverse chronological order of their creation time.

To view information about the primary link and hard links for a file on an NSS volume:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter the following to open the NSS Console:

   `nsscon`

3. At the `nsscon` prompt, enter

   `/nss /ListHardLinks=vol:`*`path\filename.ext`*

   Replace *path* with the file's primary link path or one of its hard link paths where you want to start the search. Replace *`filename.ext`* with the actual filename of the file, including the extension.

25.8 Deleting a Hard Link

If multiple links exist for a file, deleting a hard link to a file deletes only the link name, not the file's contents. NSS keeps count of how many hard links a file has and does not delete the file contents until all hard link names for the file and its primary link have been deleted (the link count goes to zero).

There are no special commands required to delete a hard link. In a file manager, locate the link name to be deleted, then delete it with the delete commands and procedures native to the client you use to access the file.

25.9 Deleting a Primary Link

When multiple hard links exist for a file, deleting its primary link does not delete the content and metadata. These are deleted only when the last remaining link is deleted. While a file has multiple links, if you delete a primary link, the most recently created hard link automatically becomes the new primary link.

If the most recently created hard link is not the link you want to become the primary link, you can delete and re-create the preferred link, then delete the primary link. Make sure you do not create any other new hard links in the meantime.

Deleting a primary link has the following consequences:

- **Order of Ascendancy:** Whenever you delete a primary link for a file with hard links, the most recently created hard link automatically becomes the new primary link.

  To identify the pathname of the hard link that is next in line to become the new primary link, see Section 25.7, "Viewing Hard Links for a File," on page 371.

  For information about primary links, see Section 25.1.1, "Hard Links and the Primary Link," on page 364
- **Effective Rights for File System Trustees:** When the inherited rights filter is applied to the new primary link's parent directory, the effective rights for trustees might change.

  For information, see Section 25.1.4, "Hard Links and File System Trustees," on page 365

- **Directory Quotas:** When the new primary link is in a different directory, the directory quotas are affected for the old and new parent directories.

  For information, see Section 25.1.5, “Hard Links and Directory Space Quotas,” on page 365

There are no special commands required to delete a primary link. In a file manager, locate the link name to be deleted, then delete it with delete commands and procedures native to the client you use to access the file.

26 Managing Files and Folders on NSS Volumes

This section provides an overview of how to manage files and folders as an administrator of a OES Storage Services (NSS) volume using the Files and Folders plug-in for iManager. For more information about using the Files and Folders plug-in to configure the file system trustees, trustee rights, inherited rights filters, and file and folder attributes, see Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301.

- Section 26.1, “Creating a Folder on an NSS Volume,” on page 375
- Section 26.2, “Deleting a File or Folder on an NSS Volume,” on page 376
- Section 26.3, “Uploading Files to an NSS Volume,” on page 377
- Section 26.4, “Downloading Files from an NSS Volume,” on page 378
- Section 26.5, “Renaming a File on an NSS Volume,” on page 379
- Section 26.6, “Moving a File to Different Folder on an NSS Volume,” on page 379
- Section 26.7, “Viewing or Modifying File or Folder Properties,” on page 380
- Section 26.8, “Viewing or Modifying File Ownership,” on page 384
- Section 26.9, “Viewing, Adding, Modifying, or Removing a Directory Quota,” on page 386

26.1 Creating a Folder on an NSS Volume

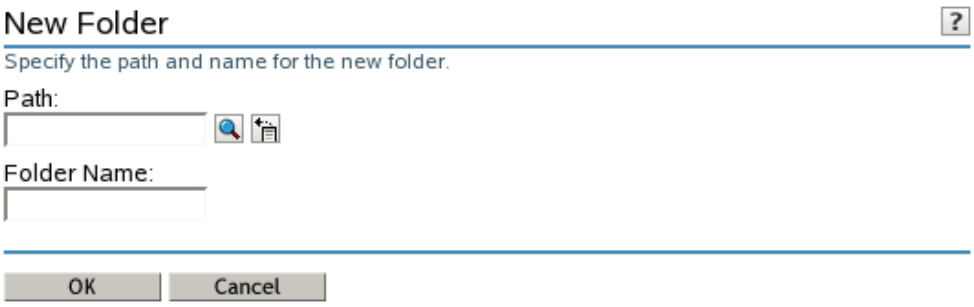
As an administrator, you can use the Files and Folders plug-in to iManager to create a folder on an NSS volume.

26.1.1 Prerequisites

- The destination NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the volume and destination location where you want to create the new folder. The Create right is required for creating files and folders.

26.1.2 Procedure

1 In iManager, click **Files and Folders**, then click **New Folder** to open the **New Folder** page.



2 Use one of the following methods to specify the destination path on the NSS volume where you want to create the new folder:

- Click the **Search** icon to browse and locate the destination folder, then click the name link of the folder to select it.
- Click the **History** icon to select a folder from the list of folders that you recently accessed.

The pathname of the folder appears in the **Path** field.

3 In **Folder Name**, type the name the folder you want to create in the selected location.

4 Click **OK** to create the folder, or click **Cancel** to abandon it.

A message confirms when the folder has been successfully created.

5 Click **Repeat Task** to create another folder, or click **OK** to dismiss the confirmation message.

6 Click **Files and Folders**, then click **Properties** to set file system trustees, trustee rights, and attributes for the new folder or folders.

For instructions for configuring properties, see Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301.

26.2 Deleting a File or Folder on an NSS Volume

As an administrator, you can use the Files and Folders plug-in to iManager to delete a file or folder on an NSS volume.

26.2.1 Prerequisites

- The NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the file or folder that you want to delete. The Erase right is required to delete the file.

26.2.2 Procedure

1 In iManager, click **Files and Folders**, then click **Delete** to open the **Delete File or Folder** page.

2 Use one of the following methods to specify the file or folder that you want to delete from the NSS volume:

- Click the **Search** icon to browse and locate the file or folder, then click the name link of the object to select it.
- Click the **History** icon to select a file or folder from the list of files and folders that you recently accessed.

The pathname of the folder appears in the **Name** field.

3 Click **OK** to delete the selected file or folder, or click **Cancel** to abandon the delete process.

A message confirms when the file or folder has been successfully deleted.

4 Click **Repeat Task** to delete another folder, or click **OK** to dismiss the confirmation message.

26.3 Uploading Files to an NSS Volume

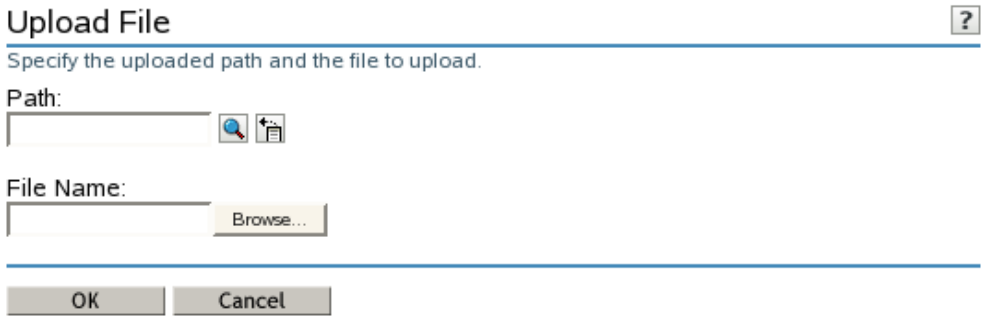
As an administrator, you can use the Files and Folders plug-in to iManager to upload files from your local computer to an existing folder on an NSS volume.

26.3.1 Prerequisites

- The destination NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the destination folder in order to be able to find the folder and upload the file. The Create right is required for file uploads.

26.3.2 Procedure

1 In iManager, click **Files and Folders**, then click **Upload** to open the **Upload File** page.



2 Use one of the following methods to specify the path to the folder on the NSS volume where you want to put the file:

- Click the **Search** icon to browse and locate the folder, then click the name link of the folder to select it.
- Click the **History** icon to select a folder from the list of folders that you recently accessed.

The pathname appears in the Path field.

3 Select the file on your local computer that you want to upload:

3a Click **Browse** to open a local file browser dialog box.

3b Browse and locate the file.

3c Select the file, then click **Open**.

The local pathname for the selected file appears in the **File Name** field.

4 Click **OK** to begin the upload, or click **Cancel** to abandon the process.

A message confirms when the file has been successfully uploaded. Wait until the upload completes before proceeding to other tasks.

5 Click **Repeat Task** to upload another file, or click **OK** to dismiss the confirmation message.

26.4 Downloading Files from an NSS Volume

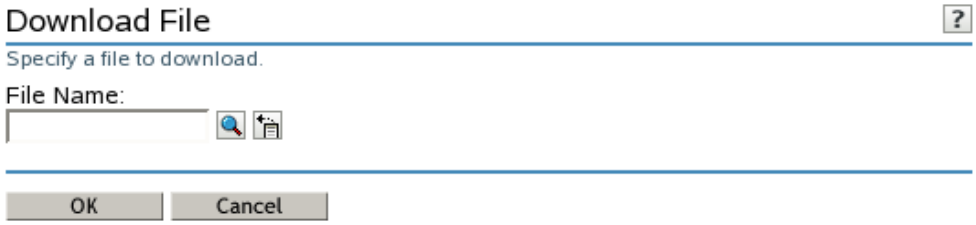
As an administrator, you can use the Files and Folders plug-in to iManager to download a file from an NSS volume to your local computer.

26.4.1 Prerequisites

- The NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the file in order to be able to browse to and download the file.

26.4.2 Procedure

1 In iManager, click **Files and Folders**, then click **Download** to open the **Download File** page.



2 Use one of the following methods to select the file that you want to download from the NSS volume to your local drive:

- Click the **Search** icon to browse and locate the file, then click the name link of the file to select it.
- Click the **History** icon to select a file from the list of files that you recently accessed.

The pathname appears in the **File Name** field.

3 Click **OK** to open the **File Download** dialog box.

IMPORTANT: If the File Download dialog box does not open, make sure the security settings in your browser allow downloads from the server by adding the server as a trusted site, then try again.

4 Use one of the following methods to save the file to the local computer:

- Click **Open** to view the file in an appropriate application, then save the file by using the application's **File > Save** options.

  The application that opens the file must already be installed on your computer.

- Click **Save** to open the **Save As** dialog box, browse to an existing folder or create a new local folder where you want to save the file, then click **Save**.

  The browser's download manager manages the download and notifies you when the download is complete.

You can continue with other iManager tasks while the file is downloading.

26.5 Renaming a File on an NSS Volume

Use this task to rename your file to a different name.

26.5.1 Prerequisites

You must have trustee rights for the file in order to be able to find the file and rename it the file. Create and modify rights are required to rename the files.

26.5.2 Procedure

1 Use one of the following methods to select the file that you want to rename:

- Click the Search icon to browse and locate the file, then click the name link of the file to select it.
- Click the History icon to select a file from the list of files that you recently accessed.

The pathname appears in the Path field.

2 Type the new name in the New name field.

3 Click OK to rename the file, or click Cancel to discard the changes.

A message confirms that the file has been successfully renamed. Wait until the rename completes before proceeding to other tasks.

26.6 Moving a File to Different Folder on an NSS Volume

Use this task to move your file to a different folder on the same NSS volume.

26.6.1 Prerequisites

You must have trustee rights for the file in order to be able to find the file and move it. Create and modify rights are required to move a file.

26.6.2 Procedure

1 Use one of the following methods to select the file that you want to move:

- Click the Search icon to browse and locate the file, then click the name link of the file to select it.
- Click the History icon to select a file from the list of folders that you recently accessed.

2 Click Browse to open a local file browser dialog box. Browse to locate and select the folder where you want to move the file, then click Open.

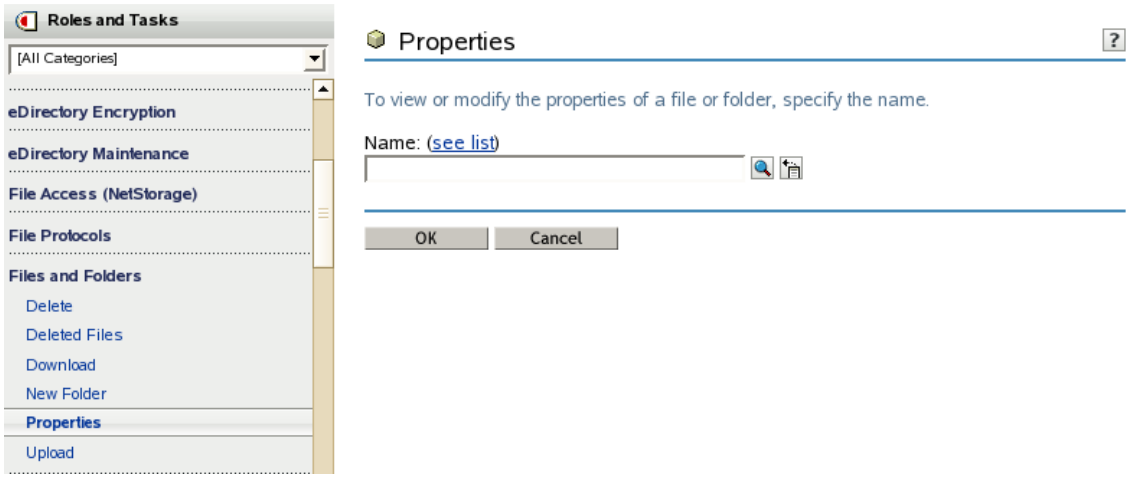
The pathname for the selected folder appears in the Folder Name field.

3 Click OK to begin the upload, or click Cancel to discard the changes.

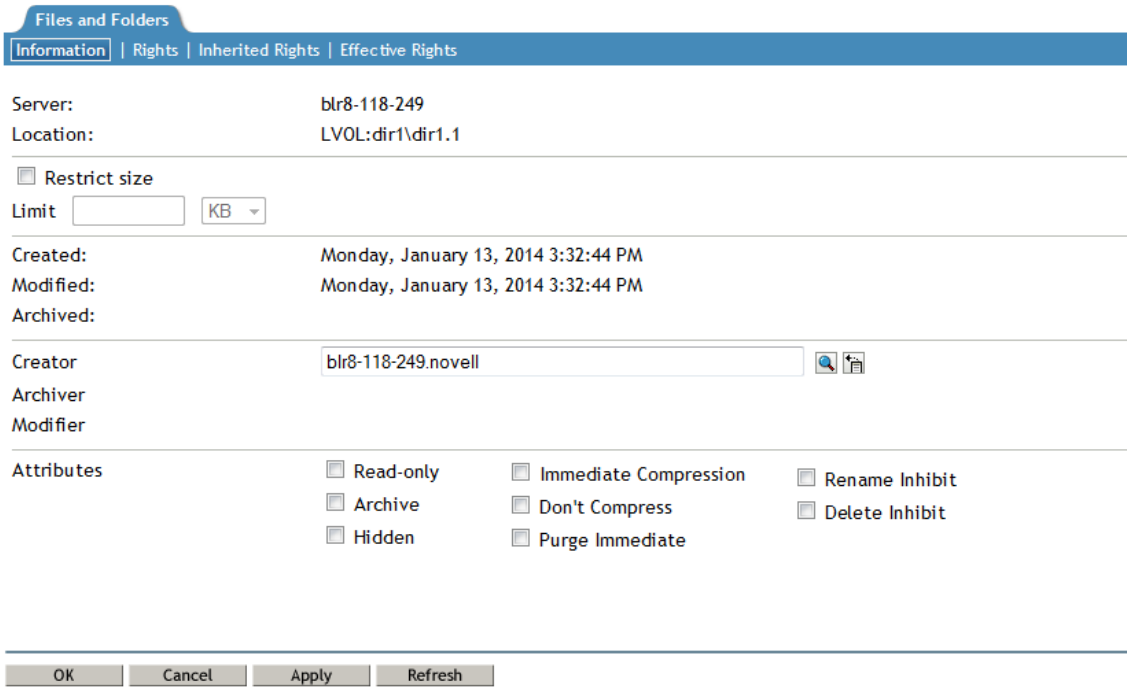
A message confirms that the file has been successfully uploaded. Wait until the upload completes before proceeding to other tasks.

26.7 Viewing or Modifying File or Folder Properties

1 In iManager, click **Files and Folders > Properties** to open the **Properties** page.



2 Click the **Search** icon to browse the Storage objects, locate and select the name link of the file or folder you want to manage, then click **OK** to view the Properties for the file.



3 Click the **Information** tab to view or modify the following information for the selected folder or file:

Property	Description
Server	The name of the server.
Location	The pathname of the selected volume, folder, or file. For example: `VOL1:dir1\dirB\filename.ext`
Size	The file size.
Restrict Size (Enable or Disable a Directory Quota on a Folder)	Enable (select) or disable (deselect) a directory quota on the specified folder on an NSS volume where the Directory Quotas attribute is enabled. The default is Disabled. If this option is enabled, you must also specify a value for the quota in the Limit field. A directory quota limits the amount of space on a volume that can be consumed by all of the files and folders in that directory. The directory quota applies to files and folders created by any user of the directory. Select **Restrict Size** to enable a directory quota for the selected folder, specify the quota value in **Limit**, then click **Apply**. Deselect **Restrict Size** to disable a directory quota for the selected folder, then click **Apply**.

Property	Description
Limit (Set Limit for a Directory Quota on a Folder)	The maximum size allowed for the specified directory and its contents. Default: Disabled (not available unless **Restrict Size** is enabled). If you enable **Restrict Size** for the selected folder, you must specify a limit for the directory quota. Type a value in KB for the quota. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder. Click **Apply** to save the changes. If the directory quota exceeds the volume quota, the volume quota is enforced. If the current size of the selected folder exceeds the specified limit, users cannot save data to the folder until space is cleared by removing files from it. If a user quota is set for a user on the volume, the user space restriction overrides the directory quota. That is, the user cannot save data to the folder if doing so causes the user to exceed his or her user quota.
Created	The time stamp (Day, Month DD, YYYY hh:mm) for when the file or folder was created.
Modified	The time stamp (Day, Month DD, YYYY hh:mm) for when the file or folder was last modified.
Accessed	The time stamp (Day, Month DD, YYYY hh:mm) for when the file or folder was last accessed.
Archived	The time stamp (Day, Month DD, YYYY hh:mm) for when the file or folder was last archived.
Creator (View or Modify Ownership)	The typeless distinguished NetIQ eDirectory username (such as username.context) of the user who created the file or folder. If the username becomes invalid, such as if an employee leaves the company, the GUID of the username is reported. For NSS, any number of files or folders can be represented by GUIDs instead of valid usernames. User quotas for NSS volumes consider file ownership to enforce user space restrictions. You might need to change the ownership of a file or folder in order to make the space it consumes be charged against a different user. For NSS volumes (as for all volumes that use the OES trustee model of access), all access to data is controlled by file system trustees and trustee rights instead of by ownership. When a user creates a file or folder, the trustees and trustee rights for accessing the file are automatically inherited from the directory where the file is created. If you intend different trustees and rights for the file, you must assign them explicitly by user, or assign the rights to a group and put the users into that group. For instructions, see Section 21.1.4, “Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter),” on page 304. Changing the ownership of the file or folder does not modify who can access it, but it does modify whose username is charged for the space it consumes. If you modify the ownership, you must click Apply or OK to save the changes.
Archiver	The distinguished username (such as username.context) of the user who modified the version of the file or folder that was last archived.

Property	Description
Modifier	The distinguished username (such as username.context) of the user who last modified the current version of the file or folder.
Attributes	File attributes determine how the file or folder behaves when accessed by any user. Enable or disable an attribute by selecting or deselecting the check box next to it. If you modify a setting, click **Apply** or **OK** to save the changes. File attributes apply universally to all users. For example, a file that has a read-only attribute is read-only for all users. Attributes can be set by any trustee with the Modify right to the directory or file, and attributes stay set until they are changed. Attributes do not change when you log out or when you down a file server. For example, if a trustee with the Modify right enables the Delete Inhibit attribute for a file, no one, including the owner of the file or the network administrator, can delete the file. However, any trustee with the Modify right can disable the Delete Inhibit attribute to allow the file's deletion.

The following table defines file system attributes and whether they apply to files, folders, or both files and folders.

Attribute	Description	Files	Folders
Read Only	Prevents a file from being modified. This attribute is typically used in combination with Delete Inhibit and Rename Inhibit.	Yes	No
Archive	Identifies files and folders that have been modified since the last backup. This attribute is assigned automatically.	Yes	Yes
Hidden	Hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
Shareable	Allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No
Purge Immediate	Flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered.	Yes	Yes
Rename Inhibit	Prevents the directory or filename from being modified.	Yes	Yes
Delete Inhibit	Prevents users from deleting a directory or file. This attribute overrides the file system trustee Erase right. When Delete Inhibit is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this attribute to allow the directory or file to be deleted. **NOTE:** Setting the following preferences override the delete inhibit and rename inhibit settings. The override option is made available via volume mount options and nsscon. ◆ From nsscon enter, `/(No)RootOverrideFA=(ALL|VOL1,VOL2)` ◆ For local volumes change the following: `/etc/fstab (-o name=<NAME>,overrideFA)` ◆ For shared volumes change the following: cluster resource load scripts (`/opt=overrideFA`) If `/RootOverrideFA` is set on the volume, the Linux `root` user can delete and rename a file.	Yes	Yes

4 If you modified any settings, click **Apply** or **OK** to save your changes.

26.8 Viewing or Modifying File Ownership

The owner of a file is assigned by default to be the identity of the user who creates the file. Ownership does not determine who can access a file because the NSS file system uses the OES trustee model to control access. However, user quotas for NSS volumes consider file ownership to enforce user space restrictions. You might need to change the ownership of a file or folder in order to make the space it consumes be charged against a different user. Changing the ownership of the file or folder does not modify who can access it, but it does modify whose username is charged for the space it consumes.

NOTE: As an administrator you can modify the file or folder ownership.

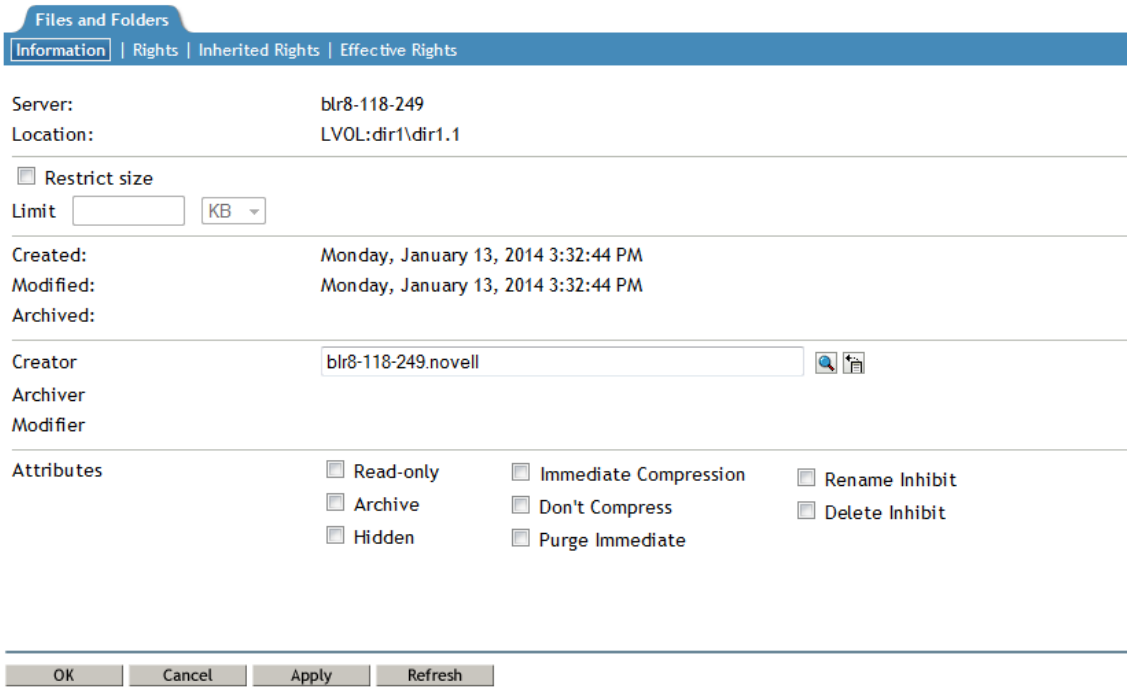
The Creator field shows the typeless distinguished NetIQ eDirectory username (such as username.context) of the user who owns the file or folder. If the username becomes invalid, such as if an employee leaves the company, the GUID of the username is reported. For NSS, any number of files or folders can be represented by GUIDs instead of valid usernames.

1 In iManager, click **Files and Folders**, then click **Properties** to open the **Properties** page.

2 Click the **Search** icon to browse and locate file from the Storage objects, click the name link of the file to select it.

The pathname of the file or folder appears in the **Name** field.

3 Click **OK** to open the file's Properties page.



NOTE: For an AD user, the creator field will be empty.

4 On the Information page, the **Creator** field shows the typeless distinguished username of the current owner, such as `username.context`.

5 If you want to modify the owner, click the **Search** icon to open the **Object Browser** dialog box, then locate and select the username of the new owner. iManager cannot be used to change the owner to an AD user. Use the nsschown command line tool (Section B.16, "nsschown," on page 515).

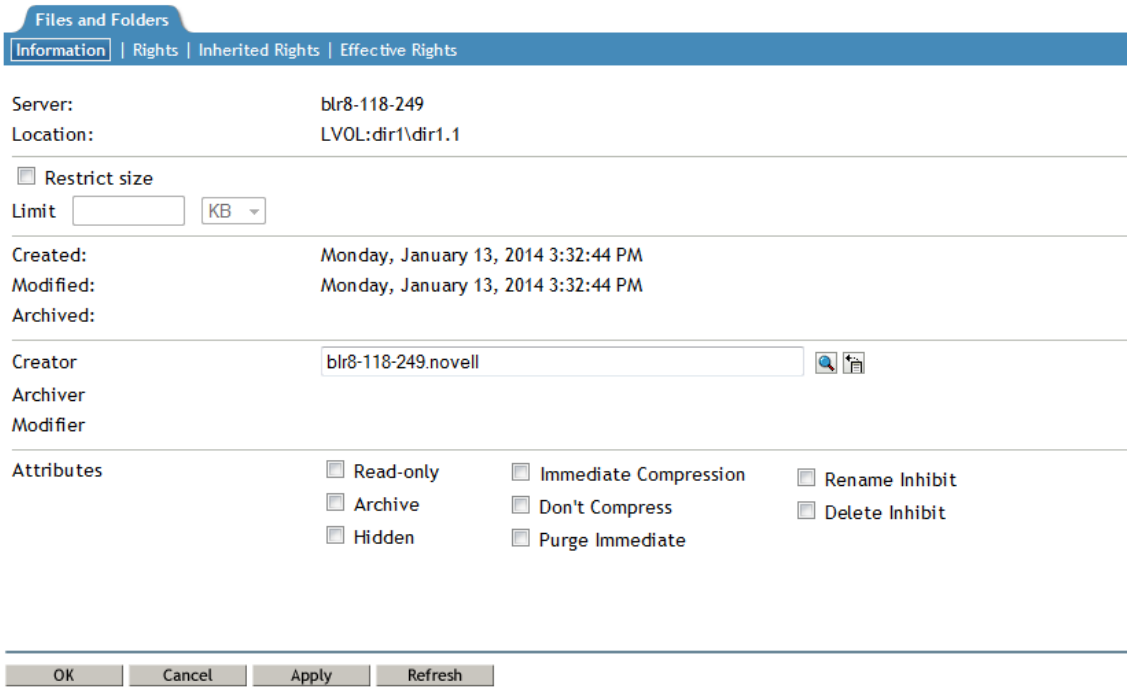
6 If you modified the owner, click **Apply** or **OK** on the Information page in order to save the change.

26.9 Viewing, Adding, Modifying, or Removing a Directory Quota

Directory quotas for NSS volumes require that the Directory Quotas attribute be set for the volume. For information, see Section 23.3.1, “Enabling or Disabling the Directory Quotas Attribute for an NSS Volume,” on page 341.

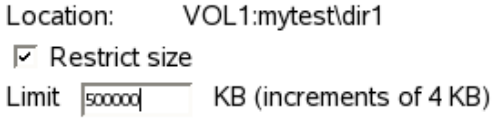
1 In iManager, select **Files and Folders > Properties**.

2 Click the **Search** icon, browse to locate and select the folder you want to manage on an NSS volume, then click **OK** to open the Properties page for the selected folder.

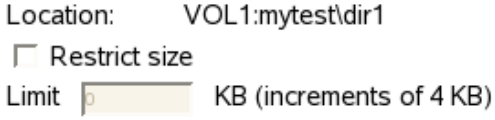


3 View the current status of the Directory Quota.

If a Directory Quota is set, the **Restrict Size** field is selected and the **Limit** field shows the quota size in KB.



If the Directory Quota is not set, the **Restrict Size** field is deselected and the **Limit** field is dimmed (grayed out).



4 Do one of the following:

- **Add a Quota:** On the **Information** tab, select **Restrict Size** to enable space restrictions for the selected directory. In the **Limit** field, type the directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
- **Modify an Existing Quota:** In the **Limit** field, type the new directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
- **Remove a Quota:** On the **Information** tab, deselect **Restrict Size** to disable space restrictions for the selected directory. The **Limit** field is automatically dimmed (grayed out).

5 On the **Information** page, click **Apply** or **OK** to apply the changes.

27 Managing Backup and Restore for Data and Trustee Information

This section describes your backup and restore options for data and trustee information for OES Storage Services volumes on Open Enterprise Server.

- Section 27.1, “Using OES Storage Management Services,” on page 389
- Section 27.2, “Using the Event File List to Refine the Backup,” on page 390
- Section 27.3, “Using METAMIG to Save and Restore Trustee Information on NSS and Linux POSIX File Systems,” on page 390
- Section 27.4, “Using Extended Attributes (xAttr) Commands,” on page 391
- Section 27.5, “Backing Up Files Without Altering the Access Time,” on page 392
- Section 27.6, “Additional Information,” on page 393

27.1 Using OES Storage Management Services

OES Storage Management Services (SMS) provide backup, restore, and data migration services for NSS volumes. For information, see the following:

- *OES 2018 SP3: Storage Management Services Administration Guide for Linux*
- *NW 6.5 SP8: SBCON Administration Guide*
- *NBACKUP Utility for OES Linux* (`nbackup(1)`): The `nbackup` utility is included in the `novell-sms` RPM file under `/opt/novell/sms/bin`. It can be used to back up and restore NSS and non-NSS volumes by using the SMS framework. It backs up and restores NSS metadata, which includes file system trustees and trustee rights information. Trustees on NSS volumes are tied to NetIQ eDirectory users and objects, so you need to protect eDirectory in addition to backing up data. The man page for `nbackup` provides further information on its usage.

  NOTE: The `nbackup` utility can be run only as an eDirectory user. Active Directory users cannot run this utility.

  Related utilities and configuration files include the following:

  - `smdrd(8)`
  - `smdrd.conf(5)`
  - `sms(7)`
  - `smsconfig(1)`
  - `tsafs(1)`
  - `tsafs.conf(5)`

  For more information on above utilities and configuration files, see respective man pages.

Encrypted NSS volumes store user data in encrypted format on the NSS volume, yet work transparently with most applications, NLM programs, and backup utilities that currently work with NSS.

SMS backs up and restores compressed files in their compressed state. It does not compress uncompressed files for backup; they are stored and restored in their uncompressed state.

27.2 Using the Event File List to Refine the Backup

NSS uses the Event File List (EFL) feature to track files that have changed on a volume during an interval called an *epoch*. It logs changes that are made to data and metadata for each active epoch on a specific NSS volume in the `_admin:manage_nss\volume\`*`volumename`*`\FileEvents.xml` file. The metadata includes changes in trustee, IRF and file attributes .

Your backup solution can take advantage of this file in order to get a list of modified files for NSS volumes. You can use the API commands in scripts to start and stop an epoch, reset the event list for an epoch, and to affect how long epochs are retained.

For information about the Event File List (EFL) APIs for developers, see "FileEvent.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services (http://developer.novell.com/documentation/vfs/vfs__enu/data/bktitle.html)*.

See Cool Tools (search for EFL) (https://www.novell.com/communities/coolsolutions/?s=EFL) on the Micro Focus Cool Solutions Web site for scripts that use the Event File List APIs.

27.3 Using METAMIG to Save and Restore Trustee Information on NSS and Linux POSIX File Systems

The `metamig` utility allows you to save and restore trustee information for NSS volumes. You can also restore trustee information for any NCP volume that was backed up as raw data with a third-party backup application. For information, see Section B.3, "metamig," on page 489.

For OES, the NCP Server allows you to create NCP volumes for Linux POSIX file systems. NSS volumes are NCP volumes by default. You can assign trustees and trustee rights for NCP volumes based on Linux POSIX file systems just as you do for NSS volumes. The trustee information is located in a hidden file on the volume rather than being integrated in the volume. When you use a third-party backup application to backup files as raw data, the trustee file is also backed up as raw data. You can use the `metamig -ncp` option to restore trustee information for NCP volumes on OES that use the NSS file system or Linux POSIX file systems.

For information about creating NCP volumes, see "Managing NCP Volumes" in the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

27.4 Using Extended Attributes (xAttr) Commands

In OES SP2 and later, NSS supports the Linux extended attributes (XAttr) option that allows listing, saving, and restoring the trustee information that is stored in the `netware.metadata` extended attribute. Third-party backup software that supports the standard Linux Extended Attributes (xattr) can use this feature for NSS volumes to preserve trustees, trustee rights, file attributes, and quotas in backup and restore.

The NSS switch, `ListXattrNWMetadata`, that helps to retrieve the list of attribute names is disabled by default. To enable it, you must set the following switches:

```
nss /ListXattrNWMetadata
nss /CtimeIsMetadataModTime
```

If you issue the commands from the command line, the support is automatically disabled at the next server reboot. You can enable the support for Linux `xattr` list across server reboots by adding the switches to the `/etc/opt/novell/nss/nssstart.cfg` file.

- Section 27.4.1, “Enabling NSS Support for Linux xAttr,” on page 391
- Section 27.4.2, “Disabling NSS Support for Linux xAttr,” on page 392
- Section 27.4.3, “Additional Information,” on page 392

27.4.1 Enabling NSS Support for Linux xAttr

- “Using NSSCON” on page 391
- “Using the nssstart.cfg File” on page 391

Using NSSCON

To enable support for Linux `xattr` list from NSSCON:

1. Open a Linux terminal console, then log in as the `root` user.
2. Start NSSCON by entering the following at the console prompt:

   ```
   nsscon
   ```

3. To enable the Linux `xattr` list support for all NSS volumes on the server, enter

   ```
   nss /ListXattrNWMetadata
   nss /CtimeIsMetadataModTime
   ```

   The commands are enabled until the next server reboot. You can also issue commands that disable the support.

Using the nssstart.cfg File

You can enable the support for Linux `xattr` list across server reboots by adding the following lines to the `/etc/opt/novell/nss/nssstart.cfg` file:

```
/ListXattrNWMetadata
/CtimeIsMetadataModTime
```

Make sure the switches are spelled correctly, and do not have spaces after the forward slash (/). If the switch names are entered incorrectly in the `nssstart.cfg` file, parsing errors can prevent the NSS pool from mounting.

27.4.2 Disabling NSS Support for Linux xAttr

- "Using NSSCON" on page 392
- "Using the nssstart.cfg File" on page 392

Using NSSCON

To disable support for Linux `xattr` list from NSSCON:

1. Open a Linux terminal console, then log in as the `root` user.
2. Start NSSCON by entering the following at the console prompt:

   ```
   nsscon
   ```

3. To disable the Linux `xattr` list support for all NSS volumes on the server, enter

   ```
   nss /noListXattrNWMetadata
   nss /noCtimeIsMetadataModTime
   ```

Using the nssstart.cfg File

If you added the switches to the `/etc/opt/novell/nss/nssstart.cfg` file, and you want the support for Linux `xattr` list to be automatically disabled after a server reboot, remove the switches from the file. When the server reboots, the Linux `xattr` list support is disabled, which is the default behavior.

27.4.3 Additional Information

For information, see Section A.11, "Extended Attributes (XAttr) Commands," on page 449.

27.5 Backing Up Files Without Altering the Access Time

You can set the `noatime` option to control whether the access time is updated when reading files and directories.

In OES 2 SP1, NSS provides the `/atime` and `/noatime` options for Linux. For information, see Section A.22, "noatime and atime Commands," on page 464.

In OES SP2 and later, NSS provides `noatime` and `nodiratime` support for the Linux `open(2)` API command, `mount` command, and the `/etc/fstab` configuration file. Backup applications can take advantage of this option to back up a file without altering its access time. For information, see Section A.23, "noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab," on page 465.

27.6 Additional Information

For a current list of backup softwares that support Open Enterprise Server, see Section 6.8, “Backup Support for NSS,” on page 74.

The data from AD-enabled volumes in OES 2015 or later cannot be migrated to volumes in OES servers older than OES 2015.

28 Tuning NSS Performance

This section describes how to tune the OES Storage Services cache buffers to improve performance on Open Enterprise Server.

- Section 28.1, “Do I Need to Tune NSS?,” on page 395
- Section 28.2, “Tuning Cache Buffers for NSS,” on page 395
- Section 28.3, “Configuring or Tuning Group I/O,” on page 396
- Section 28.4, “Tuning I/O Schedulers,” on page 401
- Section 28.5, “Configuring Delayed Block Allocation,” on page 403

28.1 Do I Need to Tune NSS?

There are many factors that contribute to decreasing server performance; however, if your server is performing poorly and you suspect the storage subsystem (NSS), you can monitor the storage subsystem by using specific NSS command line options. These options help you determine if any tuning is required. For more information, see Appendix A, “NSS Commands,” on page 439.

28.2 Tuning Cache Buffers for NSS

- Section 28.2.1, “Understanding How NSS Uses Cache,” on page 395
- Section 28.2.2, “Setting the Minimum Number of Cache Buffers to Use for Kernel Memory,” on page 396
- Section 28.2.3, “Setting the Name Cache Size,” on page 396

28.2.1 Understanding How NSS Uses Cache

NSS manages cache buffers on Linux using methods similar to those used in other Linux file systems such as Reiser, Polyserve, and XFS, with the exception of EXT.

For file data, NSS uses the Linux cache page manager to gain access to available memory in the system. There are some limits in place so that when copying large files, NSS does not starve other user applications for memory. This is similar to the cache handling used in NetWare.

For metadata, NSS uses kernel memory. NSS can use only a percentage of this space because other applications share this space. By default, NSS reserves a minimum buffer cache size of 30,000 4-KB buffers, which is about 120 MB of the kernel memory space. You can adjust the minimum number of buffers to be used by NSS with the MinBufferCacheSize parameter.

28.2.2 Setting the Minimum Number of Cache Buffers to Use for Kernel Memory

1. Open a terminal console as the `root` user.
2. Start `nsscon(8)`. At the console prompt, enter

   ```
   nsscon
   ```

3. Set the minimum number of cache buffers used by NSS. In `nsscon`, enter

   ```
   nss /MinBufferCacheSize=value
   ```

   where *value* is the number of 4-KB buffers to assign for NSS. The default value is 30000.

   The maximum setting is the amount of memory in KB divided by 4 KB.

28.2.3 Setting the Name Cache Size

The NSS Name Cache is responsible for caching the Name Tree information. This is the information that is read when you perform any kind of search by file or directory name. The Name Cache maps a name to a ZID (a unique file object ID). Directory listings do not do this as much as normal file opens that must resolve each name in the file path.

Use the NameCacheSize parameter to specify the amount of recently used Name Tree entries for files and directories that NSS caches. Each entry uses about 150 bytes of memory.

Increasing the maximum number of entries Name Cache entries does not necessarily improve the performance for getting directory listing information if NSS also needs to look up information about the file from a tree or structure outside of the name tree.

If you want to see how your name cache is performing, use the `nsscon /NameCacheStats` command.

nsscon /NameCacheSize=*value*

Specify the maximum number of recently used Name Tree entries for files and directories to cache. Name cache grows up to the specified limit. Unlike the file system cache, it does not take the maximum amount of memory allocated from the start.

Default: 100000

Range: 17 to 1000000

28.3 Configuring or Tuning Group I/O

Group write is a technique of writing data to the volume at regular intervals in order to reduce the seek time on the drive. It also reduces the number of writes because more changes to the same block are made only to memory.

In OES 1, NSS writes are done on a block-based timer. A block is written one second after the block becomes *dirty* (modified by a user or process). This can cause lots of head movement because there is no control over the order of blocks being sent to disk.

In OES 2 or later, NSS performs group writes in three categories: journal, metadata, and user data. By setting policies for group writes, you can improve the performance of the file system for your particular environment.

For information, see the following:

- Section 28.3.1, “Viewing the Metadata Area Size,” on page 397
- Section 28.3.2, “Configuring the Journal Group Write Timer,” on page 398
- Section 28.3.3, “Configuring the Metadata Group Write Timer and Limit,” on page 398
- Section 28.3.4, “Configuring the User Data Group Write Timer,” on page 400
- Section 28.3.5, “Viewing Group Write Policies,” on page 400

28.3.1 Viewing the Metadata Area Size

NSS for OES provides a logical read-ahead capability. NSS is designed to physically store logically related data near each other, such as files in the same directory. By reading ahead using the logical information, performance is increased. When a block is read, its logically related blocks are also read. The area read is determined by the default area size.

To improve the performance of NSS metadata blocks use an area seed logic to make sure that related metadata blocks are physically stored near each other. The default area size for metadata blocks is 16 blocks that are 4 KB each, or 64 KB total.

For metadata blocks, the seed is set to the block number for the area. When metadata is written, the seed logic determines the closest free block in the area to use next. When the area is new, a new free area is found in a higher area in the pool, and a new seed marks this area. When the search for a free area reaches the end of the pool, it wraps back to start searching for free areas to use at the start of the pool. If no free space of sufficient size is found, the size is temporarily halved from 16 to 8, 4, 2, or 1 blocks progressively as needed until the temporary size is 1. A setting of 1 block indicates that the pool is essentially out of space. As space is freed or the pool increases in size, future space allocations use the default area size of 16 blocks.

The maximum number of dirty data blocks that are allowed to accumulate is governed by the Metadata Group Write Limit parameter. By default, the limit is 20000 dirty blocks. For information, see Section 28.3.3, “Configuring the Metadata Group Write Timer and Limit,” on page 398.

You can view the metadata area size that is currently in use and the number of dirty blocks waiting to be written by viewing the Current Metadata Group Write Size parameter in the NSS status report. The information is reported in the following format:

```
Current Metadata Group Write Size  = areasize (number_dirty_blocks)
```

For example, with the default setting of 16 4-KB blocks, the metadata area is 64 KB. If 16000 dirty blocks are waiting to be written, the values are reported follows:

```
Current Metadata Group Write Size  = 64K (16000)
```

To view the Current Metadata Group Write Size information:

1. Open a terminal console, then log in as the `root` user.
2. At the console prompt, open the NSS Console by entering

   ```
   nsscon
   ```

3 At the nsscon prompt, enter

```
nss /status
```

4 In the NSS status report, look for the Current Metadata Group Write Size parameter to view the current values:

```
Current Metadata Group Write Size  = areasize (number_dirty_blocks)
```

28.3.2 Configuring the Journal Group Write Timer

For NSS, the journal keeps metadata consistent up to the time when its blocks are written to the device. The Journal Group Write Timer determines the elapsed time between writes of journal blocks. Thus, its timer policy determines how long ago that a consistent point is relative to a system crash.

Journal blocks are written by default as a group every second. Journal blocks might be written sooner than the one-second elapsed time if another timer policy triggers a write or if the journal gets full before the time elapses. Writing blocks as a group helps improve performance because it allows fewer writes, while ensuring that data is actually recorded to the device.

Use the following NSS command option to control the group write policy for journal blocks:

/JournalGroupWriteTime=*seconds*

Use the JournalGroupWriteTime parameter to specify the elapsed time to wait before group writes of journal blocks.

Journal Group Write Timer	Risk for Inconsistent Metadata (Time Elapsed Since Last Consistent Point)	File System Performance
1 second (default)	Minimized	Optimized for most scenarios
Greater than 1 second	Higher	Faster

To set the JournalGroupWriteTime parameter, issue the following command as the root user in the NSS Console (nsscon):

```
nss /JournalGroupWriteTime=seconds
```

Replace *seconds* with the maximum number of seconds to elapse before forcing journal blocks to be written to the volume. The default value of *seconds* is 1.

For example, to group write journal blocks every 2 seconds, enter

```
nss /JournalGroupWriteTime=2
```

28.3.3 Configuring the Metadata Group Write Timer and Limit

The metadata blocks are written by default as a group every 40 seconds, or when the MetadataGroupWriteLimit is reached, whichever occurs first. Metadata loss does not occur if the system crashes because all metadata changes are automatically recorded in the journal. However, increasing the timer setting increases the redo/undo time that is required to activate a pool (the mount time) after a crash because there is more unwritten metadata in the journal to be resolved.

IMPORTANT: Within a clustered environment, this means that the time to complete a failover is related to the setting of MetadataGroupWriteLimit parameter.

You can limit the amount of time it takes for a pool activation after a crash by decreasing the maximum number of metadata blocks that can be dirty in the MetadataGroupWriteLimit parameter. A group write is performed when the limit is reached.

You can increase performance of the file system by increasing the maximum number of metadata blocks that can be dirty.

Use the following NSS command options to control the group write behavior for metadata blocks:

/MetadataGroupWriteTime=*seconds*

Use the MetadataGroupWriteTime parameter to specify the elapsed time to wait before group writes of metadata blocks. Decreasing the metadata group write timer can help reduce the mount time for the volume after a crash.

Metadata Group Write Timer	Time to Mount After a System Crash	File System Performance
40 seconds (default)	Optimized for most scenarios	Optimized for most scenarios
Less than 40 seconds	Faster	Slower
More than 40 seconds	Slower	Faster

To set the MetadataGroupWriteTime parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

```
nss /MetadataGroupWriteTime=seconds
```

Replace *seconds* with the maximum number of seconds to elapse before forcing metadata blocks to be written to the volume. The default value of *seconds* is 40.

For example, to group write metadata blocks every 30 seconds, enter

```
nss /MetadataGroupWriteTime=30
```

/MetadataGroupWriteLimit=*blocks*

Use the MetadataGroupWriteLimit parameter to specify the maximum number of metadata blocks that can be dirty before a group write is performed. The following describes how the settings affect time to mount and file system performance:

Maximum Number of Dirty Metadata Blocks	Time to Mount After a System Crash	File System Performance
20000 blocks (default)	Optimized for most scenarios	Optimized for most scenarios
Less than 20000 blocks	Faster	Slower
More than 20000 blocks	Slower	Faster

To set the MetadataGroupWriteLimit parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

`nss /MetadataGroupWriteLimit=blocks`

Replace *blocks* with the maximum number of metadata blocks that can be dirty before forcing them to be written to the volume. The default value of *blocks* is 20000.

For example, to decrease the maximum number of dirty metadata blocks to 15,000 for the purpose of reducing the mount time, enter

```
nss /MetadataGroupWriteLimit=15000
```

For example, to increase the maximum number of dirty metadata blocks to 30,000 for the purpose of increasing the file system performance, enter

```
nss /MetadataGroupWriteLimit=30000
```

28.3.4 Configuring the User Data Group Write Timer

The user data blocks are written as a group every 3 seconds. This increases the risk of data loss on a crash compared to previous versions of NSS that write data blocks every 1 second. You can set the user data group write timer (UserDataGroupWriteTime) to 1 second to get the familiar NSS behavior for data writes.

Use the following NSS command option to control the group write behavior for user data blocks:

/UserDataGroupWriteTime=*seconds*

Use the UserDataGroupWriteTime parameter to specify the elapsed time to wait before group writes of user data blocks. Decreasing the user data group write timer can help reduce the risk of data loss for a volume after a crash.

User Data Group Write Timer	Risk of Data Loss After a Crash	File System Performance
3 seconds (default)	Optimized for most scenarios	Optimized for most scenarios
1 second	Lower, typical of NSS on NetWare and OES 2 Linux and NetWare	Slower
Greater than 3 seconds	Higher	Faster

To set the UserDataGroupWriteTimer parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

`nss /UserDataGroupWriteTime=seconds`

Replace *seconds* with the maximum number of seconds to elapse before forcing user data blocks to be written to the volume. The default value of *seconds* is 3.

For example, to group write user data blocks every 1 second, enter

```
nss /UserDataGroupWriteTime=1
```

28.3.5 Viewing Group Write Policies

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter

```
nsscon
```

3 In nsscon, enter

```
nss /status
```

4 Look for the following settings in the **Current NSS Status** report:

```
Journal Flush Timer                = 1 second
Metadata Flush Timer               = 40 seconds
User Data Flush Timer              = 3 seconds
Current Metadata Group Write Size  = 64k (16)
Metadata Block Group Write Limit   = 80000k (20000)
```

28.4 Tuning I/O Schedulers

I/O scheduling controls how read and write operations are submitted to block storage devices, such as single ATA disk systems, solid state drives, RAID arrays, and SAN storage arrays. A scheduler queues and sequences requests to reduce latency and optimize I/O performance. Configuring the best-suited I/O scheduler depends on the application workloads and storage hardware. Different combinations of workloads and storage solutions require different tuning strategies. You can configure I/O scheduler settings per storage device to optimize the performance based on the applications that access files on that device.

This section describes I/O scheduling options that can help reduce seek operations, prioritize I/O requests, and ensure that an I/O request is carried out before a given deadline. These tuning options are specifically designed for sequential physical read performance and have no impact on cache read and write performance.

For more information on the tuning parameters, see Tuning I/O Performance in the SLES 12 SP2 System Analysis and Tuning Guide.

- Section 28.4.1, “Single I/O Context (SIOC),” on page 401
- Section 28.4.2, “REQ_NOIDLE (Submit Request Without Idling),” on page 402
- Section 28.4.3, “Deadline Scheduler,” on page 402
- Section 28.4.4, “Completely Fair Queuing (CFQ),” on page 402

28.4.1 Single I/O Context (SIOC)

The SIOC option allows you to specify the same I/O context for all the kernel worker threads used by the NSS filesystem to read file contents from disk, using a Finite State Machine (FSM). Every kernel thread maintains an I/O context structure that is used by the I/O scheduler to identify the per-process CFQ queues into which the I/O request can be temporarily queued before being dispatched to the underlying logical/physical device queue. The anticipates additional consecutive disk blocks requests from the same thread, so all of the requests can be merged and submitted as one single request instead of multiple small requests. Enabling the SIOC improves I/O performance by ensuring that all related requests are placed into the same CFQ queue even if they are submitted from different NSS kernel worker threads.

This option helps improve I/O performance for file access patterns using multiple NCP/CIFS protocol clients.

To see whether this option is ON or OFF, execute `nsscon /find=iocontextsharing`

To change the setting:

1. Edit `/etc/opt/novell/nss/nsstart.cfg`.
2. Add `/IOContextSharing`.
3. Reboot the server.

28.4.2 REQ_NOIDLE (Submit Request Without Idling)

The REQ_NOIDLE NSS file system option helps physical (non-cached) reads of files from a single file system client. The option uses a flag provided by the Linux block layer to tell the CFQ I/O scheduler to place the submitted I/O request in separate CFQ queues during reads or writes, with no waiting for additional merges. The block requests submitted to the CFQ I/O scheduler are given to the underlying logical/physical disk driver without any idling.

To see whether this option is ON or OFF, execute `nsscon /find=req_noidle_enabled`

To change the setting:

1. Edit `/etc/opt/novell/nss/nsstart.cfg`.
2. Add `/REQ_NOIDLE_Enabled`.
3. Reboot the server.

28.4.3 Deadline Scheduler

The deadline scheduler applies a service deadline to each incoming request. This sets a cap on per-request latency and ensures good disk throughput. Service queues are prioritized by deadline expiration, making this a good choice for real-time applications, databases and other disk-intensive applications.

To view the current scheduler, enter the following command:

`cat /sys/block/<DEVICE-NAME>/queue/scheduler`

To change the scheduler, enter the following command:

`echo deadline > /sys/block/<DEVICE-NAME>/queue/scheduler`

This option is not persistent. When a server is rebooted, the setting returns to the default.

For a multi-path environment, change the I/O scheduler at the device mapper level.

28.4.4 Completely Fair Queuing (CFQ)

The Completely Fair Queuing (CFQ) scheduler provides a good compromise between throughput and latency by treating all competing IO processes alike. The algorithm assigns each thread a time slice in which it is allowed to submit I/O to disk, so each thread gets a fair share of I/O throughput. It also allows you to assign I/O priorities, which are taken into account during scheduling decisions.

Tune `slice_idle` parameter to improve the backup, compression and decompression performance.

To see the current value of the `slice_idle` parameter, use the following command:

```
cat /sys/block/<DEVICE-NAME>/queue/iosched/slice_idle
```

To tune the `slice_idle` parameter, use the following command:

```
echo 0 > /sys/block/<DEVICE-NAME>/queue/iosched/slice_idle
```

This is not persistent. When a server is rebooted, the setting returns to the default.

To improve the performance of the physical read in a multi-user environment, disable `low_latency` parameter using the following command:

```
echo 0 > /sys/block/<DEVICE-NAME>/queue/iosched/low_latency
```

When a server is rebooted, the setting returns to the default.

For a multi-path environment, change the I/O scheduler at the device mapper level.

28.5 Configuring Delayed Block Allocation

Delayed block allocation in OES Storage Services (NSS) helps to reduce the disk fragmentation and thereby improves the read access time. For more information, see Section 1.4.6, “Delayed Block Allocation,” on page 30.

To configure the delayed block allocation, see Section A.9, “Delayed Block Allocation Commands,” on page 448.

29 Monitoring the Status of the NSS File System and Services

This section describes the following methods for monitoring the status of OES Storage Services:

- Section 29.1, “Monitoring Status of NSS Devices, Pools, and Volumes with iManager,” on page 405
- Section 29.2, “Monitoring Compression and Salvage Statistics,” on page 406
- Section 29.3, “Monitoring Quotas and Space Usage for NSS Pools and Volumes,” on page 408
- Section 29.4, “Monitoring File System Parameters,” on page 410

29.1 Monitoring Status of NSS Devices, Pools, and Volumes with iManager

1 Use the following table to determine where to go to view the status of your NSS storage devices, pools, and volumes.

To monitor the status of:	Refer to:
Devices	Section 11.3, “Viewing Details for a Device,” on page 130
Partitioned free space	Section 11.7, “Viewing Partitions on a Device,” on page 135
Partition	Section 13.3, “Viewing Details for a Partition,” on page 179
Software RAIDs	Section 14.3, “Viewing a List of Software RAID Devices on a Server,” on page 189
Software RAID details	Section 14.4, “Viewing Details of a Software RAID Device,” on page 190
NSS pools	Section 16.8, “Viewing Pools on a Server,” on page 221
NSS pool details	Section 16.9, “Viewing Pool Details,” on page 221
NSS volumes in a pool	Section 16.11, “Viewing Volume Information for a Pool,” on page 224
NSS volume details	Section 19.6, “Viewing the Details of an NSS Volume,” on page 272
NSS volume quota and space usage	Section 19.7, “Viewing Properties of an NSS Volume,” on page 272, then click the Quotas tab

To monitor the status of:	Refer to:
NSS volume attributes	Section 19.7, “Viewing Properties of an NSS Volume,” on page 272, then click the **Attributes** tab
File and folder properties	Section 21.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 301

29.2 Monitoring Compression and Salvage Statistics

For each volume, the **Volume Properties Statistics** page in iManager reports statistics about the compressed and salvageable files in the volume, the GUID of the volume, and the block size being used.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, “Accessing Roles and Tasks in iManager,” on page 100.

2. Select a server to manage.

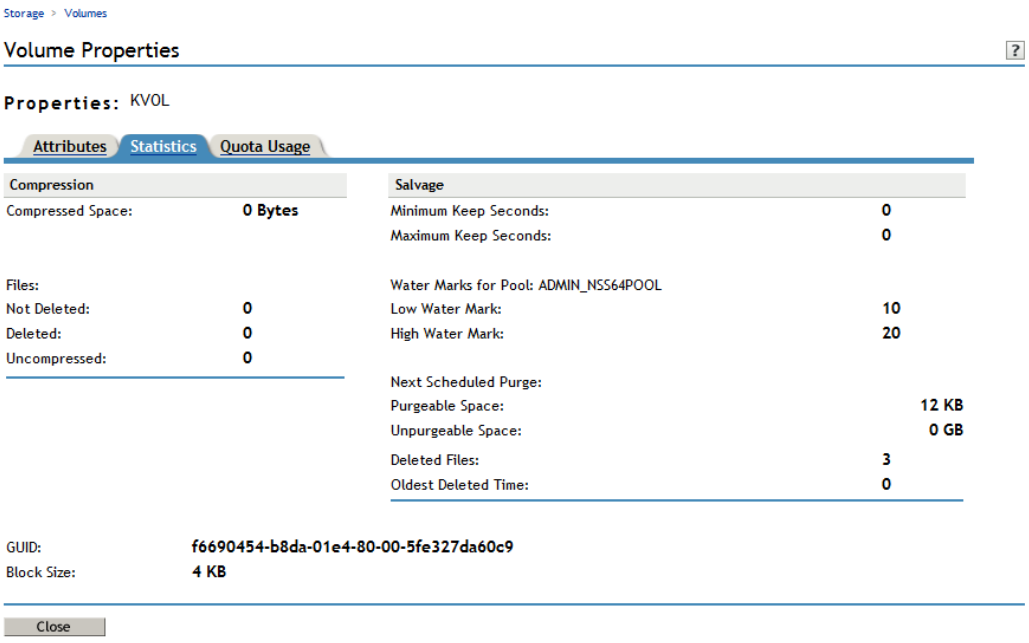
   For instructions, see Section 10.1.6, “Selecting a Server to Manage,” on page 100.

3. In the **Volumes** list, select a volume that you want manage.

4. Click **Properties**.

   The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens by default to the **Attributes** tab.

5. Click the **Statistics** tab to view the compression and salvage statistics for the selected volume.



If the compression attribute is set, the Compression report shows statistics of all the compressed files for the selected volume.

Statistic	Description
Compressed Space	The amount of space in the volume in use by compressed files.
Files	The total number of files in the volume and information by the following categories: ◆ **Not Deleted:** The total number of files in the volume that are currently available to users. ◆ **Deleted:** The total number of files in the volume that are deleted but not yet purged from the system. ◆ **Uncompressed:** The total number of files in the volume that are not stored in compressed form.

If the Salvage Files attribute is enabled, the Salvage report shows statistics about deleted files that have not yet been purged.

Statistic	Description
Minimum Keep Seconds	Minimum time (in seconds) to keep deleted files.
Maximum Keep Seconds	Maximum time (in seconds) to keep deleted files.
Low Water Mark	If the amount of free space drops below this percentage, the file system begins purging deleted files.
High Water Mark	If there are files to delete, the autopurging process stops when the amount of free space reaches this percentage.
Next Scheduled Purge	Date and time of the next purge.
Purgeable Space	Amount of space in the volume that is occupied by deleted files that are queued for purging.
Unpurgeable Space	Amount of space in the volume that is occupied by files.
Deleted Files	The number of deleted files in salvage.
Oldest Deleted Time	Time line for deleted files. The file system purges the files in the same order they were deleted.
GUID	The Global Unique Identifier (GUID) number that NSS assigns to the volume. This number is necessary so your file system can locate the specific volume.
Block Size	The maximum amount of data committed to a single write process. Possible sizes include 4, 8, 16, 32, or 64 KB.

Other information reported includes the volume's GUID and block size.

Statistic	Description
GUID	The Global Unique Identifier (GUID) number that NSS assigns to the volume. This number is necessary so your file system can locate the specific volume.
Block Size	The maximum amount of data committed to a single write process. Possible sizes include 4, 8, 16, 32, or 64 KB.

29.3 Monitoring Quotas and Space Usage for NSS Pools and Volumes

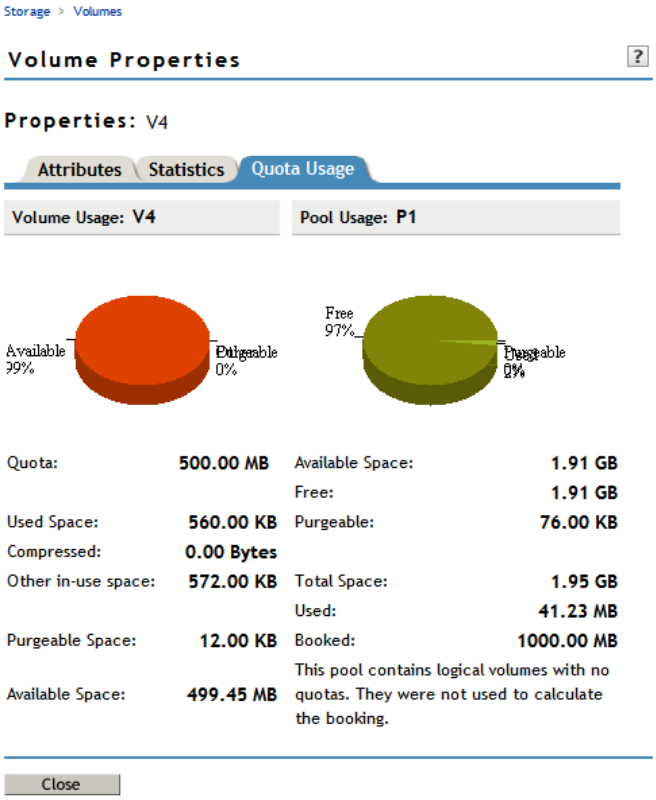
For each volume, the **Volume Properties > Quota Usage** page in iManager reports the space usage for the selected volume and the pool that contains the volume.

1. In iManager, click **Storage > Volumes**.

   For instructions, see Section 10.1.5, "Accessing Roles and Tasks in iManager," on page 100.
2. Select a server to manage.

   For instructions, see Section 10.1.6, "Selecting a Server to Manage," on page 100.
3. In the **Volumes** list, select a volume that you want manage.
4. Click Properties.

   The **Properties** page has three tabs: **Attributes**, **Statistics**, and **Quota Usage**. It opens by default to the **Attributes** tab.
5. Click the **Quota Usage** tab to view the current space usage statistics for the selected volume.



Volume Usage reports the amount of space on the volume, categorized by usage: Compressed, Other In-use, Purgeable, and Available.

Statistic	Description
Quota	Indicates whether the volume has a quota. If there is a quota, the volume can grow only to the size of the quota. If there is no quota, the volume can grow to the amount of available physical space in the pool.
Used Space	The amount of space currently in use and information by the following categories: ◆ **Compressed:** If the Compressed attribute is enabled, this is the amount of space in the volume containing data that is compressed. ◆ **Other In-Use Space:** The amount of space in the volume containing data that is not compressed. ◆ **Purgeable Space:** The amount of space in the Salvage system that you can use as free space. You can manually purge deleted files to free space. ◆ **Available:** Available free space that is not in the Salvage system.

Pool Usage reports the amount of space on the pool, categorized by usage: Free, Purgeable, Used, and Booked.

Statistic	Description
Available Space	The amount of space in the pool that is not currently in use and information by the following categories: ◆ **Free:** The total amount of free space that is available on the pool. ◆ **Purgeable:** The amount of space in the Salvage system that you can use as free space. You can manually purge deleted files to free space.
Total Space	The total amount of space allocated to the pool and information by the following categories: ◆ **Used:** The total amount of space currently in use by all volumes on the pool. ◆ **Overbooked/Booked:** If the amount of space assigned to the pool's volumes exceeds the amount of physical space available in the pool, the Overbooked field shows the amount of exceeded space. Otherwise, the Booked field shows the total amount of space in all volumes in the pool. If any of the volumes do not have a quota, these volumes are not calculated in the total combined quota.

29.4 Monitoring File System Parameters

- Section 29.4.1, "Using iManager to Monitor NSS File System Parameters," on page 410
- Section 29.4.2, "Using OES Remote Manager to Browse Directories and Files," on page 410
- Section 29.4.3, "Using OES NetStorage to Monitor NSS File System Parameters," on page 410

29.4.1 Using iManager to Monitor NSS File System Parameters

Use the File Manager plug-in to iManager to browse files and directories, and to manage access control for them. For information, see the following:

- Section 21.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 301
- Chapter 26, "Managing Files and Folders on NSS Volumes," on page 375

29.4.2 Using OES Remote Manager to Browse Directories and Files

You can browse directories and files by using OES Remote Manager for Linux. For information, see " Viewing File Systems" in the *OES 2018 SP3: OES Remote Manager Administration Guide*.

29.4.3 Using OES NetStorage to Monitor NSS File System Parameters

Use OES NetStorage to monitor the status of the NSS file system parameters listed in the following table:

Use this link	To do these tasks
Volumes	◆ Monitor or restrict disk space usage by directory (directory quotas) ◆ Purge or salvage deleted volumes or files ◆ Configure file and directory Trustee rights and Inherited Rights filters ◆ View or change a list of Set parameters

30 Troubleshooting the NSS File System

This section describes some issues you might experience with OES Storage Services (NSS) and provides suggestions for resolving or avoiding them.

For additional troubleshooting information, see the Micro Focus Support Web site (http://support.novell.com).

- Section 30.1, “NSS Server Hangs on Ceph Storage with the RADOS Block Device,” on page 414
- Section 30.2, “Deleting a Cluster Pool Using iManager Fails with an Error,” on page 415
- Section 30.3, “Rights Command Failure,” on page 415
- Section 30.4, “Cannot Connect to Target Servers from iManager,” on page 415
- Section 30.5, “Cannot See NSS Devices, Pools, or Volumes,” on page 415
- Section 30.6, “eDirectory Errors When Creating NSS Pools or Volumes,” on page 415
- Section 30.7, “File Compression is Not Working,” on page 417
- Section 30.8, “Linux Fails to Execute Dismount, Umount, or Delete Commands for NSS Volumes,” on page 417
- Section 30.9, “Multipath Devices Are Not Resolved,” on page 417
- Section 30.10, “NSS Volume Disappears from the NCP Console (ncpcon),” on page 418
- Section 30.11, “Pathname Exceeds 255-Character Limit,” on page 418
- Section 30.12, “Server Hangs When Using an NSS Volume as a Netatalk Share,” on page 418
- Section 30.13, “Slow Mount Performance for NSS Volumes Using the UNIX Name Space,” on page 419
- Section 30.14, “Software RAID 1 Fails to Recognize a Replacement Device,” on page 419
- Section 30.15, “Tuning NSS Volumes for GroupWise Servers,” on page 419
- Section 30.16, “Unknown Users as File Owners,” on page 419
- Section 30.17, “Using Scripts to Create or Manage NSS Pools and Volumes,” on page 420
- Section 30.18, “NFS Volume Mount Failure Blocks the Mounting of Other File Systems,” on page 420
- Section 30.19, “Using Linux iManager Not Able to Manage an OES Linux/NetWare Server,” on page 420
- Section 30.20, “Selecting the Device/Partition Option Which is Corrupted,” on page 421
- Section 30.21, “Salvaging an Encrypted Volume Fails After Renaming,” on page 421
- Section 30.22, “Pool Activation Fails After Aborting ravsui Verify or Rebuild Process,” on page 421
- Section 30.23, “Trustee Entries are Stored in Different Formats in NetWare and Linux Platforms,” on page 421
- Section 30.24, “Debugging of nlvm Results in the Display of Warning Messages in the nlvm_debug.log File,” on page 422

- Section 30.25, “NLVM Pool Move Fails and Deactivates the Pool,” on page 422
- Section 30.26, “Changing NameSpace of a Volume Does Not Work if the Volume is in Use on the Server When NameSpace is Changed,” on page 422
- Section 30.27, “Metamig Error When Copying Hidden or System File From Source Volume to Target Volume,” on page 422
- Section 30.28, “iManager Taking Too Long to Load User Quotas or Error in Loading User Quotas,” on page 423
- Section 30.29, “Error 23316 “No Space for Move Stamps” During a Pool Move,” on page 423
- Section 30.30, “Role-based Users not able Access Rights to Files and Folders under Modify Group,” on page 423
- Section 30.31, “An NSS32 Pool's Media Version Does not Change After Migrating to OES 2015,” on page 424
- Section 30.32, “Using the rights Utility With the -d Option Results in an Error for DST Volumes,” on page 424
- Section 30.33, “Troubleshooting NFARM,” on page 424

30.1 NSS Server Hangs on Ceph Storage with the RADOS Block Device

When you create an NSS pool and volume on Ceph storage with the RADOS block device and restart the `rbdmap.service`, the server gets hanged. This is because the NSS pool is not unmounted before getting the Ceph storage down.

To avoid this issue, perform the following:

1. Log in to the server as the `root` user.
2. Create a `stopnss.bsh` file in `/opt/novell/nss/sbin` and provide the execute permission.
3. Add the following in `stopnss.bsh`:

   ```
   #! /bin/bash
   umount -a -t nsspool
   ```

4. Go to `/etc/systemd/system/multi-user.target.wants/novell-nss.service`, and do the following changes:

   4a Add `rbdmap.service` in both the `Requires` and `After` under the "Unit" section. For example,

   ```
   [Unit]
   Requires=rbdmap.service
   After=rbdmap.service
   ```

   4b Uncomment `ExecStop` and provide the full path of `stopnss.bsh` under the "Service" section.

   ```
   [Service]
   ExecStop=/opt/novell/nss/sbin/stopnss.bsh
   ```

30.2 Deleting a Cluster Pool Using iManager Fails with an Error

When you fail to delete the cluster pool using iManager, the following error message is displayed: “Error: <poolName>: Could not delete NDS objects for this pool”. As a workaround, use `nssmu` or `nlvm` commands to delete the cluster pools.

30.3 Rights Command Failure

When a third-party application uses FUSE infrastructure to overlay its software over the NSS file system, the `rights` command might fail.

30.4 Cannot Connect to Target Servers from iManager

If you are having difficulty connecting to servers from iManager, it might be because you are using an unsupported protocol between the iManager server and the target server that you want to manage. For information, see “Interoperability of Protocols for the iManager Server and Target Server” on page 87 under the Section 8.5, “Cross-Platform Issues for Management Tools,” on page 87.

30.5 Cannot See NSS Devices, Pools, or Volumes

If you cannot see your volumes or the devices associated with those volumes, you might have a connection failure. Connection failures can occur if an adapter, cable, or switch in the path between the server and the storage device fails for any reason. If there is a connection failure, repair or reconfigure the equipment.

30.6 eDirectory Errors When Creating NSS Pools or Volumes

- Section 30.6.1, “eDirectory Error 613 When Creating an NSS Pool or Volume,” on page 415
- Section 30.6.2, “eDirectory Error 672 When Creating an NSS Pool,” on page 416
- Section 30.6.3, “eDirectory Error 601 When Creating NSS Volume,” on page 416

30.6.1 eDirectory Error 613 When Creating an NSS Pool or Volume

When creating an NSS pool or volume with NSSMU on your Linux server, an Error 613 is returned if the server has no eDirectory Read/Write replica available in the same tree when you create the pool or volume so that the Storage objects can be written to eDirectory. The error occurs because NCP (NetWare Control Protocol) cannot map to the pool or volume.

To avoid this problem, make sure the server has an eDirectory Read/Write replica. You can also add the NSS volume path to the `/etc/opt/novell/ncpserv.conf` file for NCP Server.

30.6.2 eDirectory Error 672 When Creating an NSS Pool

When creating an NSS pool by using NSSMU, iManager, or NLVM an Error 672 is returned if there is no NSS Admin object in the NetIQ eDirectory database for the server (such as *HOSTNAMEadmin.context*). NSS requires that an NSS Admin object must exist for each and every server, or management does not work.

NOTE: NSS Admin object must be placed under the default location, that is, the same place where the server object exists.

This situation occurs if you move a server across trees without also moving its NSS Admin object from one tree's eDirectory database to the other.

If you re-create the NSS Admin object, you are then able to successfully create pools.

To re-create the NSS Admin object, run `nssAdminInstall` at a Linux terminal console as the `root` user:

1. Open a terminal console, then log in as the `root` user.
2. At the console prompt, enter the following (all on the same line, of course):

   `nssAdminInstall -a 'adminname.context' -P -o 'HOSTNAMEadmin.context'`

   For example, the nssadmin user object is in the form of `server1admin.example`, where `server1` is the server name and `example` is the container where the server object also resides.

`nssAdminInstall -a 'admin.example' -P -o 'cn=server1admin.o=example'`

After the NSS Admin object is created, update the eDirectory Pool object. For information, see Section 16.15, "Updating eDirectory Pool Objects," on page 230.

30.6.3 eDirectory Error 601 When Creating NSS Volume

When the eDirectory context of the nss admin user object changes, when doing NSS Volume/Pool management operations, for example, create, rename, you might get the error 601. To avoid this problem, perform the following steps:

1. Remove the nss admin user object from eDirectory using iManager. (By default, nss admin user resides in the container where the server object resides).

   For example, the nssadmin user object is in the form of `server1admin.example`, where `server1` is the server name and `example` is the container where the server object also resides.

2. Run `nssAdminInstall` to recreate the nssadmin object.

   For example, `nssAdminInstall -a 'admin.example' -P -o 'cn=server1admin.o=example'` where `admin.example` is the context of the eDirectory admin user and `server1admin.example` is the nssadmin user object to be recreated.

   NOTE: Run the `nssAdminInstall` command on all the servers whose nssadmin object context is changed.

30.7 File Compression is Not Working

If you cannot compress a file, check the following:

- Check the Compression attribute for the volume to make sure it is enabled. To apply the file compression option to an existing NSS volume: From iManager, click **Storage > Volumes > Properties > Attributes**, select **Compression**, then click **OK**.
- Check to see if the Do Not Compress (dc) attribute for the file or directory is set.
- Review other factors that affect compression, as detailed in "Factors Affecting Compression" on page 323.

30.8 Linux Fails to Execute Dismount, Umount, or Delete Commands for NSS Volumes

When NCP Server is active, it always keeps a file open on a volume. As a result, issuing `dismount`, `umount`, or `delete` commands for an NSS volume fails, whether the command is issued from the command line, in NSSMU, or in iManager.

This occurs because Linux does not allow you to dismount a volume if a file is open on that volume. Linux does not provide a method of identifying which files are open on volumes.

To dismount or delete an NSS volume on your OES server:

1. At the server prompt, open the NCP Console by entering

   ```
   ncpcon
   ```

2. Dismount the volume from NCP.

   The volume is no longer accessible or visible to NCP clients.

3. In iManager, dismount or delete the volume, as desired.

30.9 Multipath Devices Are Not Resolved

If you have multiple interconnect paths in your server-to-storage configuration, you must use multipath management software to resolve the multiple paths into a single mutlipath device.

See Chapter 15, "Managing Multipath I/O to Devices," on page 209.

30.10 NSS Volume Disappears from the NCP Console (ncpcon)

An NSS volume might not be found by the `ncpcon` utility if the volume's mount point is renamed (the directory path is changed). For example, this might occur if you change the mount point's directory path from `/media/nss/volumename` (the default path) to `/targetpath/volumename`.

When an NSS volume is created, the NCP server gets the path to the volume and caches it, assuming that it never changes. When you later run the NCP Console (`ncpcon`) utility and enter the `volume` command, it reports the volumes that are still found at their respective mount points. Only the volumes that are still valid as compared to the list in cache are reported.

Use the following methods to avoid or resolve this problem:

- If you know in advance that you want to modify default path of the volume's mount point, make sure to create the NSS volume with iManager and change the default mount point as you configure the volume. For example, if you are setting up an NSS volume to use for the home directories, change the mount point from `/media/nss/home` to `/home`.

  Creating the volume in NSSMU does not allow for the mount point to be changed during the volume setup, only afterwards.

- To modify the mount point for an existing volume, you can use either iManager or NSSMU to change it, then restart eDirectory by entering the following at a terminal console prompt:

  ```
  systemctl restart ndsd.service
  ```

  Restarting eDirectory causes the NCP volume cache to be updated.

30.11 Pathname Exceeds 255-Character Limit

Pathnames for files on the server can have up to 255 characters, including the server name, volume name, path delimiters, filename, and file extension. If a user maps a drive letter to a location deep down the directory path, and subsequently creates a pathname that exceeds the limit for the name on the server, the file cannot be saved. Even if the file's path does not exceed 255 characters with respect to the mapped drive letter, it exceeds the maximum length on the server.

When mapping a drive letter to a folder deep down the directory path, users should adopt conventions for naming files and directories and for creating directory structures so that they do not exceed the 255-character pathname limit on the server.

30.12 Server Hangs When Using an NSS Volume as a Netatalk Share

The CopyCat application used by Netatalk uses sparse files for its database. Netatalk tries to create a CopyCat database as a sparse file called `.AppleDB` in the root of the volume by using memory mapped IO. This can cause the server to hang if you are using an NSS volume as the Netatalk share because of the limited support in NSS for this combination.

NSS has limited support for memory mapped files, primarily to support loading programs. NSS does not fully support memory mapped files especially if the application uses sparse files.

30.13 Slow Mount Performance for NSS Volumes Using the UNIX Name Space

Normally, NSS volumes mount in seconds even if the volume contains large directories with millions of files. You might observe that an NSS volume mounts slowly if it contains large directories and if you are mounting it with a UNIX name space.

To avoid this problem, mount NSS volumes with a Long name space. For information, see Section 19.11, “Mounting NSS Volumes with Linux Commands,” on page 278.

30.14 Software RAID 1 Fails to Recognize a Replacement Device

If a drive fails that is part of a software RAID 1 device, your system might not recognize the replacement drive and does not begin remirroring automatically.

To recover:

1. Reboot the system to re-scan devices and recognize the replacement drive.
2. Unmount the NSS volumes on the software RAID device to stop the I/O.
3. Expand the software RAID 1 device and specify space from the replacement drive as a new RAID segment. Remirroring begins automatically.
4. Allow the remirror to complete before mounting the NSS volumes.

30.15 Tuning NSS Volumes for GroupWise Servers

NSS performance has been dramatically improved over NetWare 6.0. As a result, the only tuning that you need to do to enhance the performance of GroupWise on NSS is to disable the salvage feature by entering the following command at the NSS Console (`nsscon`) as the `root` user.

```
nss /NoSalvage=<volumename | all>
```

30.16 Unknown Users as File Owners

In an NSS volume, a file’s owner is the user who created it. The OES trustee model for file systems is used to control access to files, so ownership is a consideration only when enforcing user quotas.

Ownership is tracked with the user’s GUID, not the username. If the username ever becomes invalid (such as if the user is deleted from the system), the file continues to be charged to that user’s GUID. In a space usage report, the value of the GUID appears in place of where the a valid username would normally be. There is no limit on the space that can be associated with unknown users. Authorized users can continue to use the files without interruption or incident.

For the user space quota, the total disk space used by the file continues to be associated with the file’s assigned owner’s GUID. User quotas can be enforced only for valid users.You must change the file’s owner to a valid user if you want the files to be included in that user’s quota.

An administrator or administrator equivalent user can assign a new owner when necessary. Changing file ownership requires the Supervisor right for the file's parent directory and the file. Use `nsschown` utility to modify the file's ownership.

30.17 Using Scripts to Create or Manage NSS Pools and Volumes

There is an XML interface that allows you to write scripts, such as Perl scripts, that will create and manage NSS pools and volumes. The API set can be downloaded from *NDK: Virtual File Services* (http://developer.novell.com/wiki/index.php/Virtual_File_Services_for_NetWare). These APIs are for NSS services on NetWare 6.0, NetWare 6.5, OES 1, OES 2, and OES 2015 servers.

Look for sample scripts at the link above or in Cool Solutions. For example:

- *NSS Pool Lister for Linux* (http://www.novell.com/coolsolutions/tools/18074.html)
- *NSS Volume Lister for Linux* (http://www.novell.com/coolsolutions/tools/18082.html)

30.18 NFS Volume Mount Failure Blocks the Mounting of Other File Systems

When mounting the volumes if the NFS volume mount fails, the subsequent file systems may fail to mount. The NFS volume mount may fail because of a problem with the NFS server or a network issue. To avoid the mount failure of the subsequent file systems, reset the default value of retry parameter of the NFS volume.

To change the value of retry parameter of NFS volume, do the following:

1. Open the `/etc/fstab` file in a text editor.
2. Edit and modify the NFS mount retry value. The default value is 10,000 minutes, which is approximately one week.

   For example, retry=5. If you have modified the default retry value to 5, the NFS server will try to remount the NFS volume for 5 minutes.

   You can change the retry value to the time you want the NFS server to retry mounting.
3. Save the file.

30.19 Using Linux iManager Not Able to Manage an OES Linux/NetWare Server

The Linux iManager cannot manage an OES Linux/NetWare server where CIMOM is not running. Check if CIMOM client is running on the server which you are trying to manage.

30.20 Selecting the Device/Partition Option Which is Corrupted

NSSMU: On selecting the Device/Partition option, displays back trace messages instead of pool details.

NLVM: On executing the NLVM list pool command, back trace messages are displayed instead of pool details.

iManager: On selecting the Device/Partition option, instead of pool details an "Error 22: Unable to get specified space on device <*device name*> is displayed.

30.21 Salvaging an Encrypted Volume Fails After Renaming

If you have renamed an encrypted volume, salvaging the volume fails with the following error:

NSSMU: Error 22703: 22703 Error mounting the volume

iManager: Error: Could not salvage iman_enc1. The volume cannot be mounted.

To resolve this error, mount the volume manually. When mounting the volume, provide the password.

30.22 Pool Activation Fails After Aborting ravsui Verify or Rebuild Process

Run a pool verify or rebuild using ravsui and interrupt the verify process using Ctrl-C. This command kills the ravsui process in user space but does not kill the background verify or rebuild kernel threads. Pool activation will succeed only after these background threads complete.

You can reattach the ravsui UI to the background running thread using the ravsui -a command. This will reattach the ravsui UI to the running rebuild or verify thread and the progress will be shown.

30.23 Trustee Entries are Stored in Different Formats in NetWare and Linux Platforms

The `trusteeinfo.xml` file shows the DN entries in “typeless” form in NetWare and in a “typed” form in Linux. After pool or volume migration to Linux from NetWare, to convert all the DN entries to the “typed” form, run the `nsscon` utility and enter the following command at the NSS Console (`nsscon`) as the `root` user:

```
nss /ForceBackgroundCheck
```

30.24 Debugging of nlvm Results in the Display of Warning Messages in the nlvm_debug.log File

When you use the debug feature for nlvm, the `nlvm_debug.log` file displays some warning messages such as "`File descriptor <file descriptor> (<file name>) leaked on <Binary name> invocation`". To turn off these warning messages, do the following:

1. Go to the file `/etc/profile`.
2. Add `EXPORT LVM_SUPPRESS_FD_WARNINGS =1`.
3. Restart your terminal console prompt.

30.25 NLVM Pool Move Fails and Deactivates the Pool

If a hardware error is encountered during an `nlvm move`, the pool move fails, and the pool is automatically deactivated. Currently, no error is returned, but the pool will not activate.

The pool move cannot continue because of the hardware error. You must delete the move (nlvm delete move [<poolname>|<movename>]) to clear the move. After the move is deleted, you can activate the pool.

Because of the hardware error, you cannot use the `nlvm move` command to move the pool. You can move the pool's data to another SAN device by restoring files from backup media, or by copying the files from the old pool to a new pool.

30.26 Changing NameSpace of a Volume Does Not Work if the Volume is in Use on the Server When NameSpace is Changed

To resolve the issue, do the following:

1. Change the namespace.
2. Umount the volume using **F7**.

   Ensure that mount point is not in use.
3. Mount the volume.

For a clustered volume, you must modify the load script to specify the name space option when mounting the volume. For information, see Section 19.10, "Configuring the Name Space for an NSS Volume," on page 277.

30.27 Metamig Error When Copying Hidden or System File From Source Volume to Target Volume

When copying the files from source volume to target volume, if the file is hidden or system file it does not get selected. It will be missing on the target volume. *trustee.nlm* or *metamig* backs up trustee information for all the files.While restoring trustee information for hidden file, metamig throws an error "`Error finding file(zERR_PATH_MUST_BE_FULLY_QUALIFIED)`.

30.28 iManager Taking Too Long to Load User Quotas or Error in Loading User Quotas

When iManager is used to load user quotas for large number of users, it might take a few minutes to load the quotas. At times the browser might become unresponsive or you might hit the "HTTP STATUS 500" error because of insufficient Java heap memory. To resolve this issue, increase the Java heap memory at `/etc/opt/novell/tomcat/conf/novell-tomcat.conf` using the following procedure:

1. In the `novell-tomcat.conf` file update the JAVA_OPTS line as follows:

   ```
   JAVA_OPTS="-Djava.library.path=/opt/novell/eDirectory/lib64:/var/opt/
   novell/tomcat/lib:/usr/lib64 -Xms1024m -Xmx2048m"
   ```

2. After saving `novell-tomcat.conf`, restart Tomcat using `rcnovell-tomcat restart` command.

30.29 Error 23316 “No Space for Move Stamps” During a Pool Move

This error occurs when the source pool has no free space to store the move stamps during a pool move operation. To resolve this issue, expand the source pool by a minimum size of 12 MB. For more information, see the TID on NSS pool move operation displays Error 23316 "No Space for Move Stamps" (http://www.novell.com/support/kb/doc.php?id=7012837).

30.30 Role-based Users not able Access Rights to Files and Folders under Modify Group

A role-based user having access to Group Management role will not be able to access Rights to Files and Folders under Modify Group by default until the File System Rights page is assigned to them.

To assign File System Rights page for RBS users:

1. Log on to iManager with administrative credentials.
2. Click **Configure > Role Based Services > RBS Configuration**.

   The list of collections for the RBS setup is displayed.
3. Click an RBS setup collection > **Property Book** tab and then select **Modify Group**.
4. From the Actions menu, click **Page List** and the Edit Page List is displayed.
5. Select **File System Rights** page from the Available Pages list, add it to the Assigned Pages, then click **OK**.

   The Files System Rights page is assigned to RBS Users.

30.31 An NSS32 Pool's Media Version Does not Change After Migrating to OES 2015

After migrating an NSS32 pool to OES 2015, its media version is incremented only if all the volumes (including the deleted and inactive volumes) in the pool are upgraded to support hard links.

Only the active volumes are automatically upgraded to support hard links. Therefore, to increment the pool media version, activate the inactive volumes, and purge or salvage the deleted volumes. To know more information on the pool media versions, see "Automatic Hard Link Media Upgrade" on page 458.

30.32 Using the rights Utility With the -d Option Results in an Error for DST Volumes

This error occurs when the trustees on the DST primary volumes are already deleted. To delete the trustees from both the primary and shadow volume, run the `rights` command with `-d` option on a DST primary volume. If the trustees of the DST primary volume is deleted without `-d` option, then the trustees on the shadow volume is not deleted causing inconsistency between both the volumes.

To resolve this issue, delete the trustees on the shadow volume without `-d` option.

30.33 Troubleshooting NFARM

- Section 30.33.1, "Deleted Files for Salvage Purge is Not Visible on a Mapped Volume," on page 424
- Section 30.33.2, "Error During Uninstallation of Salvage Purge Application on Mac," on page 425
- Section 30.33.3, "Salvage Purge Application Fails to Work When Two Volumes with Same Name Are Mapped," on page 425
- Section 30.33.4, "Salvage Purge on Mac Fails to Display the Deleted Files on SMBv1 Disablement," on page 425

30.33.1 Deleted Files for Salvage Purge is Not Visible on a Mapped Volume

On Mac, the **Deleted Files** context menu item is not visible if you access a mapped volume from OES shared drive and right-click on the volume. However, it is visible if you do a right-click inside the volume. To view this context menu item, ensure that the salvage-purge under **System Preference > Extension** check box is selected, and then relaunch the finder.

Also, whenever a new OES drive is mapped, ensure to relaunch the finder to display the **Deleted Files** in the context menu.

30.33.2 Error During Uninstallation of Salvage Purge Application on Mac

When uninstallation of salvage purge application is attempted on Mac 10.12, it errors and prompts to remove the extension manually. To uninstall the application, deselect salvage-purge under **System Preference > Extension**.

30.33.3 Salvage Purge Application Fails to Work When Two Volumes with Same Name Are Mapped

When two volumes having the same name and residing on different servers are mapped from a Mac workstation, the salvage purge application fails to work for the volume, which is mapped later. Even if the first volume mapped is unmounted and salvage purge operation is attempted, the application fails to list the files for the second volume.

30.33.4 Salvage Purge on Mac Fails to Display the Deleted Files on SMBv1 Disablement

When you right-click on a OES shared drive and click **Deleted Files**, the salvageable files are not displayed.

To resolve this issue, ensure that SMBv1 is enabled.

31 Security Considerations

This section describes security issues and recommendations for OES Storage Services for Open Enterprise Server. It is intended for security administrators or anyone who is responsible for the security of the system. It requires a basic understanding of NSS. It also requires the organizational authorization and the administrative rights to effect the configuration recommendations.

- Section 31.1, “Security Features of NSS,” on page 427
- Section 31.2, “Preventing Unauthorized Access,” on page 429
- Section 31.3, “Securing Sensitive Information During Remote Management Sessions,” on page 430
- Section 31.4, “Protecting Data During Backup and on Backup Media,” on page 430
- Section 31.5, “Preventing Exposure of Sensitive Data in a Core Dump,” on page 430
- Section 31.6, “Preventing Exposure of the Encryption Password in a Log,” on page 431
- Section 31.7, “Using Data Shredding to Prevent Unauthorized Access to Purged Files,” on page 435
- Section 31.8, “Acquiring Security Equivalence Vectors for NSS Users,” on page 435
- Section 31.9, “Protecting Modules Responsible for Security Equivalence Vectors,” on page 436
- Section 31.10, “Controlling File System Access and Attributes for NSS Volumes,” on page 436
- Section 31.11, “Displaying Directory and File Attributes for NSS Volumes,” on page 436
- Section 31.12, “Security Best Practices for zAPIs,” on page 437
- Section 31.13, “Controlling Physical Access to Servers and Resources,” on page 437
- Section 31.14, “Securing Access to the Servers With a Firewall,” on page 437
- Section 31.15, “Creating Strong Passwords,” on page 437

31.1 Security Features of NSS

Issue/Feature	Description	Recommendation	For More Information
Encrypted volume support	Encrypted NSS volumes meet the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen.	Encrypt data volumes that contain mission critical data or sensitive data. Use a strong encryption password and protect the password.	“Managing Encrypted NSS Volumes” on page 293 Section 31.15, “Creating Strong Passwords,” on page 437

Issue/Feature	Description	Recommendation	For More Information
Storage plug-in for iManager	iManager requires eDirectory authentication and SSL connections between your Web browser and the iManager server and between the iManager server and the target server being managed.	Use an Administrator user identity and a strong password. Section 31.15, "Creating Strong Passwords," on page 437	Section 10.1.7, "Storage Plug-In Quick Reference," on page 101 iManager website (https://www.netiq.com/documentation/imanager-31/)
Files and Folders plug-in for iManager	Manage trustees, trustee rights, and inherited rights filters. View effective rights. Manage file system attributes.	Use an Administrator user identity and a strong password. Section 31.15, "Creating Strong Passwords," on page 437	Section 10.1.8, "Files and Folders Plug-In Quick Reference," on page 106 Section 21.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 301 iManager website (https://www.netiq.com/documentation/imanager-31/)
NSSMU	NSSMU is executed locally on the server.	Secure physical access to servers.	Section 31.13, "Controlling Physical Access to Servers and Resources," on page 437

Issue/Feature	Description	Recommendation	For More Information
OES Remote Manager	OES Remote Manager requires eDirectory authentication and SSL connections between your Web browser and the OES Remote Manager running on the server being managed.	Use an Administrator user identity or equivalent, and use a strong password.	Section 10.5.3, "Accessing OES Remote Manager," on page 120 Section 31.15, "Creating Strong Passwords," on page 437 *OES 2018 SP3: OES Remote Manager Administration Guide* *NW 6.5 SP8: Novell Remote Manager Administration Guide*

31.2 Preventing Unauthorized Access

NSS includes the following features to help prevent access to data that circumvents normal access control:

- **Encrypted volume support**

  Encrypted volume support encrypts the volume, which makes data inaccessible to software that circumvents normal access control, such as if the media were stolen. It meets U.S. Government security standards. For information, see "Managing Encrypted NSS Volumes" on page 293.

- **Data shredding**

  The Data Shredding attribute supports shredding of purged files (up to 7 times), which erases files completely. It meets the U.S. Government security standards. For information, see Section 21.3, "Using Data Shredding to Prevent Access to Purged Files," on page 312.

- **Multiple server access prevention for pools**

  Multiple Server Activation Prevention (MSAP) ensures data integrity by preventing unauthorized access to shared media in a storage area network. For information, see Section 16.14, "Preventing Pools from Activating on Multiple Servers," on page 225.

- **OES Trustee model for access control**

  NSS uses the OES Trustee model to greatly simplify access control management in the file system. It restricts visibility of data structures so that users only see subdirectories they have rights to see, not the whole tree like all other file systems.

  For information about the OES Trustee model and NSS file system rights, see the *OES 2018: File Systems Management Guide*.

31.3 Securing Sensitive Information During Remote Management Sessions

When you are managing OES servers using iManager, all the information including sensitive data is typically sent via a Secure HTTP (HTTPS) connection between iManager and CIMOM on the Linux server you are managing. This ensures that sensitive data is not exposed during transmission. However, if CIMOM is not running on the Linux server you are managing, the plug-ins attempt to connect via NCP or CIFS. These connections are insecure and are a security concern only when transmitting sensitive information.

Effective from OES2, storage plug-ins have been modified to prevent this potential exposure of sensitive information. Where tasks involve the exchange of sensitive information between iManager and the Linux server you are managing, the plug-in now checks to see if CIMOM is running and available on the Linux server you are managing before it attempts to execute the command. If CIMOM is not running for some reason, it returns an error message and does not execute the task. The plug-ins do not allow sensitive data to be sent across insecure connections (such as NCP or CIFS) to the Linux server. You get an error message explaining that the connection is not secure and that CIMOM must be running before you can perform the task.

31.4 Protecting Data During Backup and on Backup Media

Backups of NSS volumes are not encrypted, unless it is a feature of the backup software or hardware you use. Although data is stored on an encrypted NSS volume, its data is transmitted and backed up in an unencrypted format.

Use backup methods that protect data transmitted between the server and the backup media, according to your security needs.

Use one of the following methods to encrypt the data for backup:

- Use backup software that is able to encrypt data when you back it up. This method has performance and manageability challenges, especially for managing encryption keys.
- Use an encryption appliance that encrypts sensitive backup media as data is backed up.

If you transport and store media offsite, use a company that specializes in media shipment and storage. This way, your tapes are tracked via barcodes, stored in environmentally friendly conditions, and are handled by a company whose reputation rests on its ability to handle your media properly.

31.5 Preventing Exposure of Sensitive Data in a Core Dump

When a core dump occurs for an encrypted NSS volume, data from the encrypted volume might be included in the core dump as unencrypted data dumped from cache memory. To prevent encrypted data exposure in the dump, select to exclude cache during a core dump when prompted to select writing all of memory in the core dump or to exclude NSS cache.

This applies also for volumes that are not encrypted but contain confidential data. Although the data is not normally encrypted, you might not want to allow unauthenticated access to the information.

31.6 Preventing Exposure of the Encryption Password in a Log

This section describes NSS debugger logging features so you can identify when these logs are turned on and turn them off in your operational environment.

- Section 31.6.1, “NSS Logging,” on page 431
- Section 31.6.2, “NSS Logging and Security Implications,” on page 431
- Section 31.6.3, “Logging Communications between NSS and the _ADMIN Volume,” on page 432
- Section 31.6.4, “Logging Communications between NSS and eDirectory, NICI, or Linux User Management,” on page 433

31.6.1 NSS Logging

On OES, most of the NSS code runs in kernel space, but some portions are required to run in user space. To communicate across the boundary between user and kernel space, some internal mechanisms were implemented. For debugging purposes, some logging features were added to track these communications between user and kernel space. These logging features are slow and cumbersome, and are intended for use by Micro Focus support engineers to help diagnose any problems that arise. They are not intended for everyday use, and seriously impact performance when they are turned on.

There are two main areas where logging is built into the system. The first is the capacity to log all XML communication to/from the `_ADMIN` volume. The second is the capacity to log NSS kernel requests to communicate with eDirectory, NICI, and LUM, all of which run in user space.

31.6.2 NSS Logging and Security Implications

When working with encrypted volumes it is important to realize that the volume password and key information is exchanged between user and kernel space as encrypted volumes are created and/or mounted. If you have logging enabled on the Linux server when you enter the encryption password, your password and volume key information might show up in the log file.

You must be the `root` user or an equivalent user with `root` user privileges to perform the steps required to enable logging, disable logging, or read `/var/log/messages`. This prevents ordinary users from manipulating the logging environment. We strongly recommend that you protect the physical access to the server and the `root` user passwords to prevent unauthorized access to your servers.

Even though the logging mechanisms are `root` user protected, we strongly recommend that you make sure logging is disabled whenever you plan to enter the encryption password for an encrypted NSS volume on your system. You enter an encryption password when you create the volume and when you mount the volume for the first time after any system start or reboot.

31.6.3 Logging Communications between NSS and the _ADMIN Volume

Applications such as NSSMU and Perl scripts communicate with NSS via the _admin volume. In these communications, the volume's encryption password is passed in the clear. There are two utilities that can log these exchanges, the adminusd daemon and the nss /vfs commands in NSSCON. Logs are written to /var/log/messages.

- "Prerequisite" on page 432
- "Enabling or Disabling adminusd Logging" on page 432
- "Enabling or Disabling VFS Logging" on page 433

Prerequisite

You must be the root user or an equivalent user with root user privileges to perform the steps required to enable logging, disable logging, or read /var/log/messages. This prevents ordinary users from manipulating the logging environment.

Enabling or Disabling adminusd Logging

On your OES server, an NSS daemon called adminusd is installed into /opt/novell/nss/sbin directory. It is run from the startnss.bsh script. Output data is written to the /var/log/messages directory.

- "Enabling adminusd Logging" on page 432
- "Disabling adminusd Logging" on page 432

Enabling adminusd Logging

At a Linux terminal console, do the following to enable adminusd logging:

1. Log in as the root user.
2. Kill the adminusd daemon.
3. Run the daemon with logging turned on by entering

   ```
   adminusd -l
   ```

   Using the -l option enables logging of all communication to and from the _ADMIN volume in the /var/log/messages.

Disabling adminusd Logging

At a Linux terminal console, do the following to disable adminusd logging:

1. Log in as the root user.
2. Kill the adminusd daemon.
3. Run the daemon with logging turned off by entering

   ```
   adminusd
   ```

   Not using the -l option turns logging off.
4. Delete and purge the adminusd log files in /var/log/messages.

Enabling or Disabling VFS Logging

In the NSS Console (NSSCON), the VFS option for NSS can log communications between NSS and the _ADMIN volume. The logged data is displayed on the NSSCON screen and is also written to the /var/log/messages.

Enabling VFS Logging

At a Linux terminal console, do the following to enable VFS logging:

1. Log in as the root user, then enter

   ```
   nsscon
   ```

2. In NSSCON, enter

   ```
   nss /vfs
   ```

   Logging is turned on.

Disabling VFS Logging

At a Linux terminal console, do the following to disable VFS logging:

1. Log in as the root user, then enter

   ```
   nsscon
   ```

2. In NSSCON, enter

   ```
   nss /novfs
   ```

   Logging is turned off.

3. Exit NSSCON.
4. If the terminal console logging feature was on, turn it off, then delete and purge the logged session.
5. Delete and purge the VFS log files in /var/log/messages.

31.6.4 Logging Communications between NSS and eDirectory, NICI, or Linux User Management

All internal NSS kernel space requests for NetIQ eDirectory, NICI, and Linux User Management are routed through an interface called the NDP (Novell Data Portal). NDP has a user space daemon (ndpapp) and a kernel module (ndpmod). In communications between ndpapp and ndpmod, the volume's encryption password is obscured, but it can be easily broken. Both ndpapp and ndpmod have a logging capacity, and both of them write their log data to /var/log/messages.

- "Prerequisite" on page 434
- "Enabling or Disabling ndpapp Logging" on page 434
- "Enabling or Disabling npdmod Logging" on page 434

Prerequisite

You must be the `root` user or an equivalent user with `root` user privileges to perform the steps required to enable logging, disable logging, or read `/var/log/messages`. This prevents ordinary users from manipulating the logging environment.

Enabling or Disabling ndpapp Logging

On your OES server, an NSS daemon called ndpapp is installed into `/opt/novell/nss/sbin`. It is run from the `startnss.bsh` script.

- "Enable ndpapp Logging" on page 434
- "Disable ndpapp Logging" on page 434

Enable ndpapp Logging

At a Linux terminal console, do the following to enable ndpapp logging:

1. Log in as the `root` user.
2. Kill the ndpapp daemon.
3. Run the daemon with logging turned on by entering

   ndpapp `--debug=`*nn*

   Replace *nn* with the log level desired. Set the log level to 1 and above to turn logging on. The higher the number, the greater and more detailed is the logged output.

Disable ndpapp Logging

At a Linux terminal console, do the following to disable ndpapp logging:

1. Log in as the `root` user.
2. Kill the ndpapp daemon.
3. Run the daemon with logging turned off by entering

   ndpapp

   Running ndpapp without the `--debug` option turns logging off.
4. Delete and purge the log files in `/var/log/messages`.

Enabling or Disabling npdmod Logging

- "Enabling ndpmod Logging" on page 434
- "Disabling ndpmod Logging" on page 435

Enabling ndpmod Logging

At a Linux terminal console, do the following to enable ndpmod logging:

1. Log in as the `root` user, then enter

```
echo nn >/proc/driver/ndp/debug
```

Replace *nn* with the log level desired. Set the log level to 1 and above to turn logging on. The higher the number, the greater and more detailed is the logged output.

Disabling ndpmod Logging

At a Linux terminal console, do the following to disable ndpmod logging:

1. Log in as the `root` user, then enter

   ```
   echo 0 >/proc/driver/ndp/debug
   ```

   Setting the Log Level field to 0 turns logging off.
2. Delete and purge the log files in `/var/log/messages`.

31.7 Using Data Shredding to Prevent Unauthorized Access to Purged Files

If the Data Shredding attribute for an NSS volume is disabled, unauthorized access to purged deleted files is possible. An individual can extend a file, LSEEK to the end of the existing file data, and then read the data. This returns the decrypted leftover data that is in the block.

To secure this vulnerability, make sure to enable Data Shredding for your NSS volumes by specifying an integer value of 1 to 7 times for the Data Shredding attribute. A value of 0 disables Data Shredding.

For information, see Section 21.3, “Using Data Shredding to Prevent Access to Purged Files,” on page 312.

31.8 Acquiring Security Equivalence Vectors for NSS Users

When a user authenticates to the network, the system calculates the user’s Security Equivalence Vector (SEV) based on information in the user’s profile in NetIQ eDirectory. NSS validates the user’s SEV against the file system trustee rights of the directory and file the user is attempting to access. In OES, SEVs are acquired differently for NSS on NetWare and NSS on Linux.

For NSS on NetWare, whenever a user connects to the NSS file system, NetWare retrieves the user’s SEV from eDirectory and maintains it as part of the connection structure for the user’s session. NSS automatically retrieves the user’s SEV from the connection structure.

For NSS on Linux, NSS caches the SEV locally in the server memory, where it remains until the server is rebooted or the user is deleted from eDirectory. NSS polls eDirectory at a specified interval for updates to the SEVs that are in cache. Command line switches are available in the NSS Console utility (nsscon) to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors. For information, see Section A.33, “Security Equivalence Vector Update Commands,” on page 473.

31.9 Protecting Modules Responsible for Security Equivalence Vectors

The Linux modules in user space that are responsible for providing Security Equivalence Vectors for NSS users can be replaced without the kernel module being aware of it. Make sure that the directory `/opt/novell/nss/sbin/` and the files involved (`ndpapp` and `idbrokerd`) can only be modified by the `root` user. For example, make `root` the owner and set permissions to restrict access for Group and Other users.

31.10 Controlling File System Access and Attributes for NSS Volumes

To ensure that users have the appropriate effective file system rights to data on NSS volumes, make explicit file system trustee assignments, grant security equivalences for users, and filter inherited rights. To simplify the assignment of rights, you can create Group and Organizational Role objects in NetIQ eDirectory, then assign users to the groups and roles.

Set file system attributes for directories and files on an NSS volume to specify how a file or directory is used.

For information about controlling file system access and attributes for NSS volumes, see " Understanding File System Access Control Using Trustees" in the *OES 2018: File Systems Management Guide*.

For information about access control issues for NSS, see Section 6.5, "Access Control for NSS," on page 68.

31.11 Displaying Directory and File Attributes for NSS Volumes

With NCP Server, NSS supports the OES Trustee model, which is the same file system trustee rights and attributes for its directories and files as does NSS on NetWare. Management tools provide similar methods on each platform for configuring rights and attributes. For information, see the *OES 2018: File Systems Management Guide*.

NSS on Linux displays some of the NSS file system directory and file attributes in the Linux POSIX directory and file permissions, including the Hidden, Read Only, Read/Write, and Execute attributes. These are not intended as a direct mapping of POSIX rights and behave differently. NSS does not support the POSIX set-user-ID mode bit and set-group-ID mode bit. For information, see "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *File Systems Management Guide for OES*.

31.12 Security Best Practices for zAPIs

The zAPIs for NSS create the character special device `/dev/zapi`. Because zAPIs run at a level beneath where auditing tools track access and use, you should consider restricting access on the `/dev/zapi` directory to the `root` user and setting the device's POSIX permissions to mode=0400.

If you are using AppArmor, add the following line to the AppArmor profile of any program that uses zAPIs for NSS:

```
/dev/zapi r,
```

You should grant `root` access only to members of the administrative group called `wheel`. The `root` user is a member of the `wheel` group by default. Users in the `wheel` group can access the device by using the `su` or `sudo` commands to obtain `root` privileges for any necessary tasks.

To add a user to the `wheel` group:

1. Log in as the `root` user.
2. In a terminal console, enter

   ```
   usermod -G wheel username
   ```

   Replace *username* with the username of the user being added to the `wheel` group.

Regardless of the POSIX access rights set for the device, the OES trustee model is enforced for the trustees and trustee access rights you define on `/dev/zapi` for individual users.

The key is specific to a user rather than a user-process pair. Therefore, two processes running as the same user can use the same key without requiring the second process to actually open the file. This behavior is the same as for zAPIs running for NSS on NetWare.

31.13 Controlling Physical Access to Servers and Resources

- Servers must be kept in a physically secure location with access by authorized personnel only.
- The corporate network must be physically secured against eavesdropping or packet sniffing.

31.14 Securing Access to the Servers With a Firewall

Use firewalls between public access points and servers to prevent direct access to data by a would-be third-party intruders.

31.15 Creating Strong Passwords

Make sure to employ security best practices for passwords, such as the following:

- **Length:** The minimum recommended length is 6 characters. A secure password is at least 8 characters; longer passwords are better.

- **Complexity:** A secure password contains a combination of letters and numbers. It should contain both uppercase and lowercase letters and at least one numeric character. Adding numbers to passwords, especially when added to the middle and not just at the beginning or the end, can enhance password strength. Special characters such as &, $, and > can greatly improve the strength of a password.

  Do not use recognizable words, such as proper names or words from a dictionary, even if they are bookended with numbers. Do not use personal information, such as phone numbers, birth dates, anniversary dates, addresses, or ZIP codes. Do not invert recognizable information; inverting bad passwords does not make them more secure.
- **Uniqueness:** Do not use the same passwords for all servers. Make sure to use separate passwords for each server so that if one server is compromised, all of your servers are not immediately at risk.
- **nssadmin User Object:** Do not modify the password of the nssadmin user object even though the iManager GUI provides an option to modify passwords of the user objects.

A NSS Commands

This section describes commonly used OES Storage Services command line options for Open Enterprise Server (OES) servers. The commands are grouped by management tasks.

- Section A.1, “Using NSS Commands,” on page 440
- Section A.2, “Help and Find Commands,” on page 441
- Section A.3, “Access Time Command,” on page 442
- Section A.4, “Background File System Checker Commands,” on page 442
- Section A.5, “Cache Management Commands,” on page 442
- Section A.6, “Compression Commands,” on page 444
- Section A.7, “Data Shredding Commands,” on page 447
- Section A.8, “Daylight Savings Time Commands,” on page 447
- Section A.9, “Delayed Block Allocation Commands,” on page 448
- Section A.10, “eDirectory Storage Object ID Commands,” on page 449
- Section A.11, “Extended Attributes (XAttr) Commands,” on page 449
- Section A.12, “Event File List (EFL) Command,” on page 452
- Section A.13, “NSS Media Upgrade Commands,” on page 452
- Section A.14, “I/O Write Commands,” on page 459
- Section A.15, “LAF Audit Log Messages Commands,” on page 460
- Section A.16, “Load Commands for the nssstart.cfg File,” on page 461
- Section A.17, “Low Storage Alert Messages Commands,” on page 461
- Section A.18, “Migration Support Commands for Near-Line Storage,” on page 462
- Section A.19, “Modified File List (MFL) Commands,” on page 462
- Section A.20, “Multipath I/O Failover Commands,” on page 462
- Section A.21, “Multiple Server Activation Prevention (MSAP) Commands,” on page 463
- Section A.22, “noatime and atime Commands,” on page 464
- Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 465
- Section A.24, “Opportunistic Locking Commands,” on page 467
- Section A.25, “Pool Freeze and Thaw Commands,” on page 468
- Section A.26, “Pool Management Commands,” on page 468
- Section A.27, “Pool Snapshot Commands,” on page 469
- Section A.28, “Pool Verify and Rebuild Commands,” on page 469
- Section A.29, “POSIX Permission Mask Command,” on page 469
- Section A.30, “Quotas Commands,” on page 470
- Section A.31, “Read Ahead Blocks and Allocate Ahead Blocks Commands,” on page 470

- Section A.32, “Salvage and Purge Commands,” on page 472
- Section A.33, “Security Equivalence Vector Update Commands,” on page 473
- Section A.34, “Sendfile API Support Command,” on page 476
- Section A.35, “Status Commands,” on page 476
- Section A.36, “Visibility Rebuild Command,” on page 477
- Section A.37, “Volume Management Commands,” on page 478
- Section A.38, “ZID Commands,” on page 481

A.1 Using NSS Commands

- Section A.1.1, “Issuing NSS Commands at Command Consoles,” on page 440
- Section A.1.2, “Making NSS Commands Persist Through a Reboot,” on page 440
- Section A.1.3, “Permissions,” on page 441
- Section A.1.4, “Descriptions,” on page 441

A.1.1 Issuing NSS Commands at Command Consoles

Enter NSS commands at the NSS Console (NSSCON, `nsscon(8)`) on an OES server. For information about NSSCON, see Section B.4, “nsscon,” on page 493.

A.1.2 Making NSS Commands Persist Through a Reboot

NSS commands issued at the command line do not persist through a server reboot. To make non-persistent command settings persist automatically through a server reboot, place the commands in the `nssstart.cfg` file, which NSS reads on startup. The file is in the `/etc/opt/novell/nss` directory. Some commands cannot be used in the `nssstart.cfg` file. Refer to the individual commands for information.

1. In a text editor, create a file called `nssstart.cfg` in the `/etc/opt/novell/nss/` directory.
2. Enter any NSS commands that you want to persist through server reboots.

   Each NSS command should be preceded by a forward slash (`/`) and followed with a space.

   For example, the `ListXattrNWmetadata` option enables the ability to return the `netware.metadata` extended attribute for a file or directory at `listxattr(2)` time. The `ADIdentities` option AD-enables all the volumes. This applies to volumes on both local and shared pools. The volumes whose pools are not AD media-upgraded are ignored.

   ```
   /numworktodos=40 /ListXattrNWmetadata /ADIdentities=all
   ```

   NOTE: Whenever you place an NSS command in the `nssstart.cfg` file, ensure not to prefix those commands with nss.
3. Save and close your `nssstart.cfg` file.

A.1.3 Permissions

You must be logged in as the `root` user, or as a Linux user with equivalent privileges.

A.1.4 Descriptions

The descriptions of commands provide information about the default values, range of valid values, and persistence of the command.

Default Value

The default value is the setting used for a given server configuration parameter. Initially, the value reported is the default setting for the parameter. If you modify the value, it reports the actual value.

IMPORTANT: Default values are the best choice for a majority of server configurations, but you can modify the settings to meet your needs.

Range of Valid Values

The range of valid values establishes the constraints for any particular variable setting.

Persistence

If a command's setting is persistent, the value or policy you set remains in effect for the server through any subsequent server reboots until you next modify the settings. If a command is not persistent, the setting remains in effect only until the next server reboot. Some commands can be issued in the `nssstart.cfg` file in order to make the settings persist across reboots.

The file is `/etc/opt/novell/nss/nssstart.cfg`. For information, see Section A.1.2, "Making NSS Commands Persist Through a Reboot," on page 440.

A.2 Help and Find Commands

The `help` and `find` options provide information about various NSS switches and a brief description of the parameter. Enter the options at the `nsscon` prompt in the NSS Console.

/find *search_criteria*

To find a particular NSS switch, use the `/find` switch. Replace *search_criteria* with the characters to use in the search. Wild cards searches where you replace some characters with an asterisk (*) are allowed.

For example, the following command finds all of the NSS command options that contain the word "compress":

```
nss /find=*compress*
```

/help or /?

To access online Help for NSS commands, enter one of the following:

```
nss /help
nss /?
```

A.3 Access Time Command

nss /(No)UpdateAccessTimeForReaddir

Enable or disable the ability to update the access time when enumerating directories. Enabled is the default POSIX behavior.

Default: On

Examples

To enable access time to be updated when files in a directory are accessed for listing, enter

```
nss /UpdateAccessTimeForReaddir
```

To disable access time to be updated when files in a directory are accessed for listing, enter

```
nss /NoUpdateAccessTimeForReaddir
```

A.4 Background File System Checker Commands

The background file system checker checks the integrity of user ID metadata, directory quota metadata, and files every 90 days. Beginning with OES 2015, this duration has been reduced from 90 days to 30 days. The output goes to the `nsscon` prompt. There is no built-in report to follow the process of a background check.

nss /(No)BackgroundChecking

Enables or disables the background file system checker.

Default: On (enabled)

Examples

To enable background checking, enter

```
nss /BackgroundChecking
```

To disable background checking, enter

```
nss /NoBackgroundChecking
```

ForceBackgroundCheck

Forces the background file system checker to start.

A.5 Cache Management Commands

Use the commands in this section to manage the cache for NSS volumes.

- Section A.5.1, “Cache Command,” on page 443
- Section A.5.2, “ID Cache Commands,” on page 443

- Section A.5.3, “Cache Monitoring Commands,” on page 443
- Section A.5.4, “UnplugAlways Command for the Read Queue,” on page 444

A.5.1 Cache Command

nss /MinBufferCacheSize=*value*

Sets the specified minimum number of NSS buffer cache entries, where *value* is the number of 4-KB buffers to assign for NSS.

Default: 30000 for NSS

Range: 10000 for NSS to the amount of memory in KB divided by 4 KB (the block size).

A.5.2 ID Cache Commands

Use the following command at the `nsscon` prompt in order to synchronize the cache of eDirectory IDs that is maintained for controlling access to NSS volumes.

nss /IDCacheResetInterval=*value*

Set the number of seconds between invalidation of the ID cache.

Default: 90000

Range: 0 to 200000000

ResetIDCache

Reset the various eDirectory ID caches.

If you Linux-enable a user who has been logged into the system before being Linux-enabled, ensure to execute the `resetidcache` command from the NSS Console (`nsscon`) utility. This allows proper reporting of ownership because it resets the mapping of user identities in the ID cache and forces it to update with the Linux UID for the user.

If you LUM disable the user, ensure to execute the `resetidcache` command from the NSS Console (`nsscon`) utility. Run this command after 30 minutes, because NCP server clears its cache periodically at the interval of 30 minutes. This allows proper reporting of ownership because it resets the mapping of user identities in the ID cache.

nss /IDCacheSize=*value*

Sets the maximum number of entries for NSS GUID to ID and ID to GUID cache.

For example, nss /IDCacheSize = 256000

Default: 16384

Range: 16384 to 524288

A.5.3 Cache Monitoring Commands

CacheStats

Shows the caching statistics for buffers.

ResetStats

Resets caching and file statistics.

A.5.4 UnplugAlways Command for the Read Queue

nss /(no)UnplugAlways

When enabled, this option allows NSS to unplug the device queue after queuing each read. This improves performance significantly on certain workloads, such as Linux copy (cp) command.

NOTE: In OES 2 SP1, the UnplugAlways default setting is on (enabled). OES 2 SP2 onwards, the UnplugAlways default setting is off (disabled).

For OES 2 and OES 2015 the UnplugAlways default setting is off (disabled). The OES 2 version of this option is available as patch *OES Storage Services (NSS) and OES Cluster Services (NCS) 20080806* (oes2-novell-nss-5503) for 32-bit and 64-bit architectures. The patch is available on the Micro Focus Downloads Web site (http://download.novell.com).

Examples

Enable UnplugAlways by entering the following at the `nsscon` prompt as the `root` user:

```
nss /UnplugAlways
```

Disable UnplugAlways by entering the following at the `nsscon` prompt as the `root` user:

```
nss /NoUnplugAlways
```

A.6 Compression Commands

Use the commands in this section to manage compression parameters for NSS volumes where the Compression attribute has been enabled. After compression is enabled for a volume, it cannot be disabled.

- Section A.6.1, “Server-Level Compression Parameters,” on page 444
- Section A.6.2, “Volume-Level Compression Parameters,” on page 446

A.6.1 Server-Level Compression Parameters

Server-level compression parameters apply to all NSS volumes on the server. For details about each parameter, see Section 22.2.1, “Understanding Server-Level Compression Parameters,” on page 325.

nss /CompressionDailyCheckStartingHour=*value*

Default: 0

Range: 0 to 23

Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.).

nss /CompressionDailyCheckStopHour=*value*

Default: 6

Range: 0 to 23

Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.).

nss /DaysUntouchedBeforeCompression=*value*

Default: 14

Range: 0 to 100000 (in days)

nss /(No)EnableFileCompression

Enable file compression on volumes where the Compression attribute is enabled. Immediate Compress requests are queued until compression is allowed.

Default: On

Range: On or Off

Examples

To enable compression, enter

```
nss /EnableFileCompression
```

To disable compression, enter

```
nss /NoEnableFileCompression
```

nss /MinimumCompressionPercentageGain=*value*

The minimum percentage a file must compress in order to remain compressed.

Default: 20

Range: 0 to 50

nss /MaximumConcurrentCompressions=*value*

The number of simultaneous compressions allowed by the system (simultaneous compressions can only occur if there are multiple volumes).

Default: 2

Range: 1 to 8

nss /ConvertCompressedToUncompressedOption=*value*

Specify what the file system does with an uncompressed version of a file after the server has decompressed it.

IMPORTANT: Before a compressed file can be opened, there must be sufficient space available on the volume for the uncompressed and compressed copies of the file to coexist while the file is open.

Default: 1

Range: 0, 1, or 2

0 = Always leave the file compressed.

While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. If the file is closed without changes, the uncompressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. After the modified file is closed, it is queued for immediate compression. Sufficient space must be available for both the compressed and uncompressed copies of the file to temporarily coexist on the volume in order for the compression to occur. After successful compression, the uncompressed copy of the modified file is discarded.

1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter. This is the default behavior for compression.

While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. The first time that the file is closed without changes in the specified period, the uncompressed copy of the file is discarded. The second time that the file is closed without changes in the specified period, the compressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.

2 = Always leave the file uncompressed.

While the compressed file is open, both the uncompressed and compressed copies of the file coexist on the volume. When the file is closed or when changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.

nss /DecompressPercentDiskSpaceFreeToAllowCommit=*value*

The percentage of disk space on a volume that is required to be free in order for file decompression to permanently change the compressed file version to uncompressed, which prevents newly uncompressed fils from entirely filling up the volume. Compressed files that are written to are always left uncompressed.

Default: 10

Range: 0 to 75

nss /DecompressFreeSpaceWarningInterval=*value*

The time interval (in minutes) between displaying warning alerts when the file system is not permanently changing compressed files to uncompressed files due to insufficient free disk space.

Setting the interval to 0 turns off the alert.

Default: 31 minutes

Range: 0 to 720 (0 seconds to 29 days 15 hours 50 minutes 3.8 seconds)

Setting the interval to 0 turns off the alert.

nss /DeletedFilesCompressionOption=*value*

Specifies whether and when to compress deleted files. This command presumes that you have enabled the Salvage attribute for NSS volumes. If Salvage is disabled, deleted files are purged immediately, so there are no deleted files to compress.

Default: 1

Range: 0, 1, or 2

0 = Do not compress deleted files.

1 = Compress deleted files the next day.

2 = Compress deleted files immediately.

A.6.2 Volume-Level Compression Parameters

NSS offers volume-level commands in this section for configuring and monitoring compression on a specified NSS volume.

nss /Compression=<*volumename* | all>

Enables the Compression attribute for the specified volume or for all volumes on the server. After you enable the Compression attribute, the setting persists for the life of the volume. You cannot disable compression, but you can set parameters to effectively turn it off. For information, see Chapter 22, “Managing Compression on NSS Volumes,” on page 319.

nss /StopNormalCompression, or StopNormalCompression

Stops all queued compression for files, based on the compression triggered by a file open or close.

nss /(No)BGCompression

Allows compression to occur in the background at any time, instead of only within specified hours.

nss /NoBGCompression

Stops background compression and clears any queued background compression requests. Allow compression to occur only within the specified hours.

A.7 Data Shredding Commands

nss /(No)DataShredding=*volumename*:*count*

Enables or disables the Data Shredding attribute for the specified volume. Specify the number of times you want to shred data.

Data shredding overwrites purged files with bit patterns up to seven times. Unless you must use this feature for security reasons, it should be disabled, because data shredding consumes a great deal of disk I/O bandwidth.

Default: 1

Range: 1 to 7, where 0 indicates no shredding

Examples

To enable data shredding on a volume VOL1 where the purged files are overwritten 7 times, enter

```
nss /DataShredding=VOL1:7
```

To disable data shredding for a volume VOL1, enter

```
nss /NoDataShredding=VOL1
```

A.8 Daylight Savings Time Commands

Use the commands in this section to manage daylight savings time for NSS volumes.

nss /DaylightSavingsTimeOffset=*value*

Issuing this command causes UTC time to be recalculated from local time. Specify the offset applied in time calculations when daylight savings time is in effect.

Default: +1 (one hour)

Range: 0 to 23

nss /StartOfDaylightSavingsTimeOffset=*value*

Local date and time when the switch on to daylight savings time should occur. Formats include a simple date and time enclosed in quotes, or rule enclosed in quotes and parenthesis. For example:

```
"April 1 2008 2:0:0 am"
```

```
"(April Sunday > 1 2:0:0 am)"
```

```
"(April Sunday First 2:0:0 am)"
```

Only rules cause rescheduling for the next year. You must set both the start and end dates before either is scheduled.

```
[Value=none]
```

nss /EndOfDaylightSavingsTimeOffset=*value*

Local date and time when the switch off of daylight savings time should occur. Formats include a simple date and time enclosed in quotes, or rules enclosed in quotes and parenthesis. For example:

```
"October 31 2008 2:0:0 am"
```

```
"(October Sunday <= 31  2:0:0 am)"
```

```
"(October Sunday Last 2:0:0 am)"
```

Only rules cause rescheduling for the next year. You must set both the start and end dates before either is scheduled.

[Value=none]

A.9 Delayed Block Allocation Commands

nss /(No)DelayedAlloc

Enables or disables the delayed block allocation at the server level.

Default: On

Range: On or Off

Examples

To enable delayed block allocation, enter

```
nss /DelayedAlloc
```

To disable delayed block allocation, enter

```
nss /NoDelayedAlloc
```

NOTE: If `volumeStatusFlags` element contains DELAYED_ALLOC value in `VolumeInfo.xml`, the volume is eligible for delayed block allocation. For example,

```
<volumeStatusFlags>DELAYED_ALLOC</volumeStatusFlags>
```

A.10 eDirectory Storage Object ID Commands

Use the commands in this section to remove or update the Storage objects in NetIQ eDirectory.

nss /RemoveObjectIDStore

Remove the object store.

nss /UpdateObjectIDStore

Scan and add all volume objects to an existing object store.

A.11 Extended Attributes (XAttr) Commands

The Extended Attributes (XAttr) extension for NSS provides accessibility into many extended attributes for NSS. It allows you to read, back up, and restore extended attributes of files on NSS. This section describes options to determine how extended attributes are handled for NSS.

- Section A.11.1, “CtimeIsMetadataModTime Option,” on page 449
- Section A.11.2, “ListXattrNWmetadata Option,” on page 449
- Section A.11.3, “Additional Information,” on page 452

A.11.1 CtimeIsMetadataModTime Option

By default, the Linux `ctime` is mapped to NSS create time (CreateTime). We prefer that `ctime` be based on the NSS metadata modified time (MetadataModifiedTime) instead of the NSS create time, but modifying the Linux `ctime` function might cause unknown complications. Thus, NSS provides the `CtimeIsMetadataModTime` option to allow an administrator to select to map the metadata modified time as the Linux `ctime` value, rather than the NSS create time when the different time stamp matters for your deployment.

The `CtimeIsMetadataModTime` option can be set persistently in the `/etc/opt/novell/nss/nssstart.cfg` file, or it can be set from `nsscon` by a user with `root` access.

nss /CtimeIsMetadataModTime

Maps the NSS metadata modified time to Linux `ctime`. This is the default behavior in OES 2 and later.

nss /noCtimeIsMetadataModTime

Maps the NSS create time to Linux `ctime`.

A.11.2 ListXattrNWmetadata Option

- “ListXattrNWmetadata Option” on page 450
- “Security Issues for ListXattrNWmetadata” on page 450
- “Using the Linux cp Command to Copy Files with Extended Attributes” on page 451
- “Using the Linux rsync Command to Copy Files with Extended Attributes” on page 451

ListXattrNWmetadata Option

In OES 2 and later, the NetWare metadata (`netware.metadata`) extended attribute was added for files and directories. The `ListXattrNWmetadata` option for NSS allows a user or application with `root` access to select whether the `netware.metadata` extended attribute is returned for a file or directory at `listxattr(2)` time. The `ListXattrNWmetadata` option is disabled (OFF) by default. This option is intended for use by indexing or backup programs.

For users or applications without `root` access (without the `CAP_SYS_ADMIN` capability), the `listxattr(2)` command never lists the `netware.metadata` extended attribute, regardless of the `ListXattrNWmetadata` setting.

The `ListXattrNWmetadata` option can be set persistently in the `/etc/opt/novell/nss/nssstart.cfg` file, or it can be set from `nsscon` by a user with `root` access as follows:

nss /(No)ListXattrNWmetadata

Enables or disables the ability to return the `netware.metadata` extended attribute for a file or directory at `listxattr(2)` time.

The option is disabled by default in all OES versions. Enable the option if there is a need to use the Linux `xattr` functions to access or change NetWare metadata fields by name.

- **Off:** `listxattr()` does not return “netware.metadata” as an extended attribute for NSS files and directories. It is still possible to get extended attributes (`getxattr()`) and set extended attributes (`setxattr()`) by using the specific `xattr` name:

  `"netware.metadata"`

- **On:** `listxattr()` returns “netware.metadata” as an extended attribute for NSS files and directories.

Examples

To enable the return of netware.metadata information, enter the following in the NSS Console:

```
nss /ListXattrNWmetadata
```

To disable the return of netware.metadata information, enter the following in the NSS Console:

```
nss /NoListXattrNWmetadata
```

Security Issues for ListXattrNWmetadata

The `ListXattrNWmetadata` option is available only to the user or application with `root` access (the `CAP_SYS_ADMIN` capability). It is disabled (off) by default.

When this feature is enabled (on) (such as by the backup user or by third-party backup software), and if the user or application has `root` user access, the following occurs:

- When copying NSS files or directories with the Linux `cp` utility from NSS volumes to NSS volumes, the `cp` utility copies the trustees assigned to a file or directory to the destination file or directory. This means that the old trustees of the file or directory now have visibility into the destination directory. In addition, the old trustees inherit trustee rights from the destination directory for other files in that directory.

NOTE: For users or applications without `root` access (without the CAP_SYS_ADMIN capability), the trustee information is not copied to the destination directory.

- When copying NSS files with the `cp` utility from NSS volumes to non-NSS volumes, the `cp` utility issues a warning message advising that it could not apply the `netware.metadata` extended attribute.

NOTE: For users or applications without `root` access (without the CAP_SYS_ADMIN capability), the `cp` utility does not attempt to apply the `netware.metadata` extended attribute.

There is no work-around for these two copy-related issues for the user or application with `root` access. This is how the Linux `cp` utility works.

Using the Linux cp Command to Copy Files with Extended Attributes

The Linux `cp` command has changed from OES 2 onwards. In OES 1, when `listxattr` is enabled, the extended attributes are also copied when you use the `cp` command as the `root` user to copy files. However in OES 2 and later, in order to copy the extended attributes, you must use the `--preserve` option.

The man page of `cp` on OES 2 and later provides the following description of the `--preserve` option:

--preserve[=ATTR_LIST]
Preserve the specified attributes (default: mode,ownership,timestamps), if possible additional attributes: links, xattrs, all.

For example, after you enable `listxattr`, you can copy a file and its `netware.metadata` by logging in as the `root` user, then entering the following at a terminal console prompt:

```
cp --preserve=all /path/file1 /newpath/file1
```

Using the Linux rsync Command to Copy Files with Extended Attributes

When using the Linux `rsync` command to copy files with extended attribute, use the `rsync -A` and `-X` options. For example:

```
rsync -A -X -av test/ test2/
```

Options	Description
`-A, --acls`	preserve ACLs (implies `-p`)
`-X, --xattrs`	preserve extended attributes
`-p, --perms`	preserve permissions

A.11.3 Additional Information

For information about how to use the XAttr Extension for NSS, see the *NDK: XAttr Extension for NSS* (https://www.microfocus.com/documentation/open-enterprise-server-developer-documentation/xattr-extension-for-nss/).

For information about how to use the Linux `listxattr(2)` command, see the man page (enter `man 2 listxattr` at a terminal console prompt).

Micro Focus Cool Solutions has a listxattrs tool you can use to check if you get the extended attributes after enabling `/ListXattrNWmetadata`. The listxattrs tool can be downloaded from the **Cool Solutions > Cool Tools > List Extended Attributes with xattr APIs** (http://www.novell.com/coolsolutions/tools/18206.html).

A.12 Event File List (EFL) Command

For information about the Event File List (EFL) feature for developers, see "FileEvent.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services (https://www.microfocus.com/documentation/open-enterprise-server-developer-documentation/virtual-file-services/)*.

nss /ResetEFLTree=*volumename*

Reset the Event File List (EFL) tree on the given volume.

A.13 NSS Media Upgrade Commands

Use the commands in this section for managing AD, Trustee Index and hard links media upgrade.

- Section A.13.1, "NSS Media Upgrade Commands," on page 452
- Section A.13.2, "Automatic Pool Media Upgrade Commands," on page 457
- Section A.13.3, "Hard Links Commands," on page 458

A.13.1 NSS Media Upgrade Commands

This section provides the commands to upgrade the NSS pools to AD or Trustee Index media.

- "AD Media" on page 453
- "Trustee Index Media" on page 455
- "Pool and Volume Media Version" on page 456

AD Media

When an NSS32 pool is migrated to OES 2015 or later, all its active volumes are automatically media upgraded to support hard links. For more information, see “Automatic Hard Link Media Upgrade” on page 458

All NSS32 pools must be AD media upgraded in order to support AD users. NSS64 pools are by default Trustee Index media (includes AD media) upgraded. Use the commands in this section to upgrade the existing NSS32 media to support AD users or to enable all future NSS32 pool creation to be automatically created with the AD user support.

For the Existing NSS Pools

nss /PoolMediaUpgrade=poolname /MediaType=AD

Upgrades the specified NSS pool to support AD media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015.

The following commands can also be used to upgrade the existing NSS32 pool media to support AD users.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=poolname

Upgrades the file system media format of a particular NSS32 pool to support AD users.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all /include=shared

Any NSS32 shared pools created after running this command will be AD media enabled.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all /include=local

Any NSS32 local pools created after running this command will be AD media enabled.

nss /ZLSSUpgradeCurrentPoolMediaFormatToAD=all

Any NSS32 pools (shared or local) created after running this command will be AD media enabled.

NOTE: Media upgrading a shared NSS32 pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceADMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015. For more information, see “Behavior of an NSS Pool Resource with Media Version 44.03 and Above in Mixed Node Cluster” in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

For the Newly Created NSS Pools

The commands placed in the `nssstart.cfg` file persists across server reboots. If the NSS commands are added in the `nssstart.cfg` file, ensure those commands are not prefixed with nss.

If these commands are issued from the command line, it persists only till a server reboot.

nss /NewPoolMediaFormat=AD /include=all

Sets the file system media format of all the newly created pools (shared or local) to support AD media.

nss /NewPoolMediaFormat=AD /include=shared

Sets the file system media format of all the newly created shared pools to support AD media.

nss /NewPoolMediaFormat=AD /include=local

Sets the file system media format of all the newly created local pools to support AD media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015.

The following commands can also be used to enable all future NSS32 pool creation to be automatically created with the AD user support.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all

Upgrades the file system media format of all the newly created NSS32 pools (shared or local) to support AD users.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all /include=shared

Upgrades the file system media format of all the newly created NSS32 shared pools to support AD users.

nss /ZLSSUpgradeNewPoolMediaFormatToAD=all /include=local

Upgrades the file system media format of all the newly created NSS32 local pools to support AD users.

NOTE: Media upgrading a shared NSS32 pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceADMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015. For more information, see "Behavior of an NSS Pool Resource with Media Version 44.03 and Above in Mixed Node Cluster" in the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.

Volume AD-enabling

Use the following commands to AD-enable the volumes. Only after AD-enabling, the AD users will be able to access the NSS resources based on the access rights assignment. Before running these commands, ensure that the pools on which these volumes exist are NSS AD media-upgraded.

nss /ADIdentities=volume_name

AD-enables the specified volume.

nss /ADIdentities=all

AD-enables all the volumes. The volumes whose pools are not AD media-upgraded are ignored.

nss /(No)EnableNewVolumeToAD

Enables or disables the automatic AD-enabling of new volumes.

The commands placed in the `nssstart.cfg` file persists across server reboots. If this NSS command is added in the `nssstart.cfg` file, ensure this command is not prefixed with nss.

If this command is issued from the command line, it persists only till a server reboot.

Default: Off

Range: On or Off

Examples

To enable automatic AD-enabling of new volumes, enter

```
nss /EnableNewVolumeToAD
```

To disable automatic AD-enabling of new volumes, enter

```
nss /NoEnableNewVolumeToAD
```

Trustee Index Media

The OES Storage Services (NSS) volumes use the Trustee Model to secure access to directories and files. The Trustee Model allows you to assign users as trustees of directories and files on the NSS volumes. The model's inheritance feature allows the subdirectories and files to inherit rights from a parent directory or masks the rights that should not be inherited. The Trustee Index tree stores the list of directories and files in the NSS volumes that are having trustees and IRF (Inherited Rights Filter). The ZIDs (iNode number) in NSS consists of ACLs (with trustees and IRFs) that are stored in volumes in the Trustee Index tree. These ZIDs helps you to scan the trustee information for OES URM, NFARM, and so on at any given path in the NSS volume. Therefore, NSS requires a media upgrade to pool and volume to support Trustee Index. For more information on Trustee Model, see Section 6.5.3, "OES Trustee Model," on page 71.

Use the `nsscon` commands in this section to upgrade the existing NSS media to support Trustee Index or to enable all future NSS pool creation to be automatically created with the Trustee Index support.

For the Existing NSS Pools

nss /PoolMediaUpgrade=poolname /MediaType=TrusteeIndex

Upgrades the specified pool to support Trustee Index media.

For the Newly Created NSS Pools

The commands placed in the `nssstart.cfg` file persists across server reboots. If the NSS commands are added in the `nssstart.cfg` file, ensure those commands are not prefixed with nss.

If these commands are issued from the command line, it persists only till a server reboot.

nss /NewPoolMediaFormat=TrusteeIndex

Sets the file system media format of all the newly created pools (shared or local) to support Trustee Index media.

nss /NewPoolMediaFormat=TrusteeIndex /include=shared

Sets the file system media format of all the newly created shared pools to support Trustee Index media.

nss /NewPoolMediaFormat=TrusteeIndex /include=local

Sets the file system media format of all the newly created local pools to support Trustee Index media.

NOTE: Media upgrading a shared NSS pool in a mixed-node cluster environment is not recommended. You can still force the upgrade using the `/ForceMedia` switch. After the forceful media upgrade, the pool will not load in nodes older than OES 2015 SP1.

Pool and Volume Media Version

In NSS32 and NSS64 pool type, the pool status can be determined by the media version. Table A-1 provides information about the NSS32 and NSS64 pool type media version.

Table A-1 *NSS Pool Media Version Details*

Pool Media Version	Description
XX.YY	◆ **XX:** Denotes the major version of the pool. ◆ **YY:** Denotes the minor version of the pool.
43.02	◆ **43:** An NSS32 pool that does not support AD. ◆ **02:** Some volumes are not upgraded to support hard links.
43.03	◆ **43:** An NSS32 pool that does not support AD. ◆ **03:** All volumes are upgraded to support hard links.
44.02	◆ **44:** An NSS32 pool that supports AD. ◆ **02:** Some volumes are not upgraded to support hard links.
44.03	◆ **44:** An NSS32 pool that supports AD. ◆ **03:** All volumes are upgraded to support hard links.
45.00	◆ **45:** An NSS32 pool that supports Trustee Index. ◆ **00:** Some volumes are not upgraded to support Trustee Index.
45.01	◆ **45:** An NSS32 pool that supports Trustee Index. ◆ **01:** All volumes are upgraded to support Trustee Index.
51.00	◆ **51:** An NSS64 pool that supports AD by default. ◆ **00:** All volumes are upgraded to support hard links.
52.00	◆ **52:** An NSS64 pool that supports Trustee Index. ◆ **00:** Some volumes are not upgraded to support Trustee Index.
52.01	◆ **52:** An NSS64 pool that supports Trustee Index. ◆ **01:** All volumes are upgraded to support Trustee Index.
53.00	◆ **52:** An NSS64 pool that supports AES.

Similarly, the volume status can also be determined by the media version. Table A-2 provides information about the NSS volume media version.

Table A-2 *NSS Volume Media Version Details*

Volume Media Version	Description
38.05	◆ **38:** An NSS volume that supports Hard Link. ◆ **05:** An NSS volume is upgraded to support hard links.
41.00	◆ **41:** An NSS volume that supports Trustee Index. ◆ **00:** An NSS volume is not upgraded to support Trustee Index.
41.01	◆ **41:** An NSS volume that supports Trustee Index. ◆ **01:** An NSS volume is upgraded to support Trustee Index.

A.13.2 Automatic Pool Media Upgrade Commands

Use the following command to automatically upgrade the NSS32 and NSS64 pools to latest pool media (Trustee Index). The automatic pool media upgrade happens only if the pool is AD media enabled. Whenever an AD media enabled pool is activated, the pools are automatically upgraded to support latest media.

Media upgrading an NSS32 pool to AD, automatically upgrades the pool to latest media. However, creating an NSS64 pool, will automatically creates the pool with latest media.

The commands placed in the `nssstart.cfg` file persists across server reboots. If this NSS command is added in the `nssstart.cfg` file, ensure this command is not prefixed with nss.

If this command is issued from the command line, it persists only till a server reboot.

nss /(No)PoolMediaAutoUpgrade=*value*

Enables or disables the pool media to upgrade automatically. If enabled, the pools are automatically upgraded to support the latest media (Trustee Index).

Default: Off

Range: ZLSS, ZLSS64, or both (with comma separated)

Examples

To enable the pool media to upgrade automatically for NSS32 pool, enter

```
nss /PoolMediaAutoUpgrade=ZLSS
```

To enable the pool media to upgrade automatically for NSS64 pool, enter

```
nss /PoolMediaAutoUpgrade=ZLSS64
```

To enable the pool media to upgrade automatically for both NSS32 and NSS64 pool, enter

```
nss /PoolMediaAutoUpgrade=ZLSS,ZLSS64
```

To disable the pool media to upgrade automatically for NSS32 pool, enter

```
nss /NoPoolMediaAutoUpgrade=ZLSS
```

To disable the pool media to upgrade automatically for NSS64 pool, enter

```
nss /NoPoolMediaAutoUpgrade=ZLSS64
```

To disable the pool media to upgrade automatically for both NSS32 and NSS64 pool, enter

```
nss /NoPoolMediaAutoUpgrade=ZLSS,ZLSS64
```

NOTE: For clustered pools, the automatic pool media upgrade occurs only in homogeneous cluster environment. For local pools, the automatic pool media upgrade occurs both in homogeneous and mixed-node cluster environment.

A.13.3 Hard Links Commands

Use the commands in this section for managing hard links capability for NSS volumes.

- "Automatic Hard Link Media Upgrade" on page 458
- "Hard Links Attribute Commands" on page 458
- "Hard Links Management Commands" on page 458

Automatic Hard Link Media Upgrade

When an NSS32 pool is migrated to OES 2015 or later, all its active volumes are automatically media upgraded to support hard links.

Once all the volumes in the pool are upgraded to support hard links, the pool media version is incremented. If there are deleted and inactive volumes, they are not media upgraded; therefore, the pool media version is not incremented. To know the pool media version, execute the `PoolMediaVersion` command in NSSCON.

Hard Links Attribute Commands

Use the commands in this section to enable or disable the Hard Links attribute for an NSS volume. The Hard Links attribute cannot be set or viewed in NSSMU or in the Storage plug-in to iManager.

nss /HardLinks=*volumename*

Enables the Hard Links attribute for the specified volume. This enables hard links to be created on the volume.

nss /HardLinks=all

Sets the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

nss /NoHardLinks=*volumename*

Disables the Hard Links attribute for the specified volume. Existing hard links continue to function, but no new hard links can be created on the specified volume.

nss /NoHardLinks=all

Disables the Hard Links attribute for all NSS volumes on the server. Existing hard links continue to function, but no new hard links can be created on any NSS volume on the server.

Hard Links Management Commands

You can view a report of hard links for a file to identify its primary link and the hard link that becomes the primary link if the primary link is deleted. For information, see Section 25.7, "Viewing Hard Links for a File," on page 371.

/nss /ListHardLinks=vol:*pathfilename.ext***

View information about the primary link and hard links for a file on an NSS volume.

Replace *path* with the file's primary link path or one of its hard link paths where you want to start the search. Replace *`filename.ext`* with the actual filename of the file, including the extension.

Use the `/volumes` option to verify that the Hard Links attribute is enabled.

nss /volumes

View a list of NSS volumes on the server and information about them. In the Attributes column, the **HardLinks** attribute is listed if it is enabled for the volume.

A.14 I/O Write Commands

Use the commands in this section to control the write behavior of dirty blocks from the cache to the disk. These commands are available for OES 2 and later. For more information about using these commands, see Section 28.3, "Configuring or Tuning Group I/O," on page 396.

nss /JournalGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of journal blocks.

Replace *seconds* with the maximum number of seconds to elapse before forcing journal blocks to be written to the volume. The default value of *seconds* is 1.

Example

To group write journal blocks every 2 seconds, enter

```
nss /Journal GroupWriteTime=2
```

nss /MetadataGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of metadata blocks. Decreasing the metadata group write timer can help reduce the mount time for the volume after a crash.

Replace *seconds* with the maximum number of seconds to elapse before forcing metadata blocks to be written to the volume. The default value of *seconds* is 40.

Example

To group write metadata blocks every 30 seconds, enter

```
nss /MetadataGroupWriteTime=30
```

nss /UserDataGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of user data blocks. Decreasing the user data group write timer can help reduce the risk of data loss for a volume after a crash.

Replace *seconds* with the maximum number of seconds to elapse before forcing user data blocks to be written to the volume. The default value of *seconds* is 3.

Example

To group write user data blocks every 1 second, enter

```
nss /UserDataGroupWriteTime=1
```

nss /MetadataGroupWriteLimit=*blocks*

Specify the maximum number of metadata blocks that can be dirty before a group write is performed.

Replace *blocks* with the maximum number of metadata blocks that can be dirty before forcing them to be written to the volume. The default value of *blocks* is 20000.

Examples

To decrease the maximum number of dirty metadata blocks to 15,000 for the purpose of reducing the mount time, enter

```
nss /MetadataGroupWriteLimit=15000
```

To increase the maximum number of dirty metadata blocks to 30,000 for the purpose of increasing the file system performance, enter

```
nss /MetadataGroupWriteLimit=30000
```

nss /FastWriteOfMessyBeasts

This enables or disables the fast update of messy files.

Example

To disable the fast update of messy files, enter

```
nss /NoFastWriteOfMessyBeasts
```

To enable the fast update of messy files, enter

```
nss /FastWriteOfMessyBeasts
```

A.15 LAF Audit Log Messages Commands

Use the NSS audit log messages commands to enable or disable messages via Lightweight Auditing Framework (LAF) for NSS trustee changes for NSS volumes on OES 2 and later. When it is enabled, NSS reports changes for the following subset of NSS events:

- Adding trustees (AddTrustee)
- Removing trustees (RemoveTrustee)
- Setting the inherited rights mask (SetInheritedRightsMask)

The messages are stored in the `/var/log/audit/audit.log` file. For information about the content and format of messages in the log, see Section 21.4.1, “Understanding NSS Audit Log Messages,” on page 313.

nss /(No)LAFAuditTrustee

Enable or disable the generation of audit messages via Lightweight Auditing Framework for NSS trustee changes for NSS volumes.

After you enable the audit log messages, the setting persists until the server reboot. After a server reboot, the audit log is disabled again by default. To make the command persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file.

To have the setting persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: Off (disabled)

Values: On or Off

Examples

To enable NSS audit messages, enter the following at the `nsscon` prompt:

```
nss /LAFAuditTrustee
```

To disable NSS audit messages, enter the following at the `nsscon` prompt:

```
nss /NoLAFAuditTrustee
```

A.16 Load Commands for the nssstart.cfg File

Use the commands in this section to load the services automatically by placing them in the `nssstart.cfg` file in the `/etc/opt/novell/nss` directory.

nss /(No)SkipLoadModules

If enabled, skips the auto-loading of the NSS support modules.

Default: Off

/NumWorkToDos=*value*

If used in the `nssstart.cfg` file, sets the number of WorkToDo entries. Entries can execute concurrently.

NSS uses WorkToDo entries for tasks such as flushing file metadata to disk in the background. Increasing the number of WorkToDo entries might be useful on a system that is heavily used. NSS always reserves 20 WorkToDo entries.

Default: 50

Range: 5 to 100

/zLSS

If it is specified in the `nssstart.cfg` file, loads only those modules that are essential for zLSS support.

A.17 Low Storage Alert Messages Commands

nss /(No)StorageAlertMessages

Enables or disables NSS to send Low Storage messages to all users.

Default: On

nss /StorageAlarmThreshold=*value*

Sets the threshold (in MB) for a Low Storage space warning.

Default: 10

Range: 0 to 1000000

nss /StorageResetThreshold=*value*

Resets the threshold (in MB) for a Low Storage space warning.

Default: 10

Range: 0 to 1000000

A.18 Migration Support Commands for Near-Line Storage

nss /(No)Migration=<*volumename* | all>

Enables or disables migration of files on the specified volumes to a third-party near-line storage system.

This option is used only for third-party vendor applications that provide near-line storage. It is not a migration tool for migrating data from NetWare to Linux, and it is not associated with Dynamic Storage Technology.

A.19 Modified File List (MFL) Commands

Use the commands in this section to manage the Modified File List (MFL) feature for NSS volumes. The MFL attribute enables NSS to create a list of all files modified since the previous backup. The log is available only through third-party software.

nss /(No)MFL=*volumename*

Enables or disables the Modified File List attribute for the specified volume.

Examples

To enable the MFL attribute for a given volume, enter

```
nss /MFL=volumename
```

To disable the MFL attribute for a given volume, enter

```
nss /NoMFL=volumename
```

nss /MFLVerify=*volumename*

Compares the modified file list with the specified volume and reports any inconsistencies.

nss /FixMFL=*volumename*

Repairs the modified file list to be consistent with the file system.

nss /GetMFLStatus=*volumename*

Shows the modified file list status for the specified volume.

A.20 Multipath I/O Failover Commands

The Media Manager multipath I/O management is not available for Linux. For devices on Linux, use the Linux multipath I/O management tools. For information, Chapter 15, “Managing Multipath I/O to Devices,” on page 209.

A.21 Multiple Server Activation Prevention (MSAP) Commands

Use the commands in this section to prevent NSS pools from being concurrently active on multiple nodes. The management file for pool Multiple Server Activation Prevention (MSAP) is `_admin\manage_nss\pool\ poolname\zlss\msap.xml`. One file exists for each pool. This file contains MSAP statistics for the pool. The MSAP attribute is displayed in the enabledAttributes tag of the `poolinfo.xml` management file.

For `manage.cmd`, the pool operation `getPoolInfo` returns the MSAP tag (`<msap>`) in the supportedAttributes tag (`<supportedAttributes>`) and the enabledAttributes tag (`<enabledAttributes>`).

For APIs, the pool feature `zpool_feature_msap` can be viewed and controlled using the `zGetInfo` and `zModifyInfo` commands.

nss /MSAPServer

Enables MSAP for all the pools on the server. By default, MSAP is enabled for every pool on the server. We recommend that you never disable MSAP.

nss /NoMSAPServer

Disables MSAP for all the pools on the server. This command remains in effect only until the server is rebooted. We recommend that you never disable MSAP.

nss /MSAPRebuild=*poolname*

Rebuilds a corrupt MSAP block. If the MSAP block for a pool becomes corrupt, it prevents a pool from going into Maintenance state. Use this command to rebuild the MSAP block for a given pool. Before issuing the command to rebuild, you must deactivate the pool. Rebuilding an MSAP block does not give the rebuilder ownership of the pool.

nss /PoolMSAP=*poolname*

Enables MSAP for a given pool on the server. MSAP is enabled the next time the pool is activated. (Enter the command, deactivate the pool, then activate the pool. MSAP is now enabled.)

nss /NoPoolMSAP=*poolname*

Disables MSAP for a given pool. Use the command when the pool is activated. MSAP is disabled the next time the pool is activated. (Enter the command, deactivate the pool, then activate the pool. MSAP is now disabled.)

nss /MSAPServerID=*id*

Sets the ID for MSAP to use to uniquely identify the server.

nss /MSAPIDDisplay

Displays current IDs used by MSAP.

nss /pools

Displays the message **Multi-Use Detect** for NSS pools that have MSAP enabled.

A.22 noatime and atime Commands

The /noatime and /atime commands for a volume allow the administrator to control whether access times are updated when files and directories are read. They are available for NSS on OES 2 SP1 and later. The setting persists across reboots.

Using /noatime is useful for backup, news servers, and mail servers where the extra disk activity associated with updating the access time is not desired. Avoiding the writes associated with updating the access time can result in measurable performance gains.

WARNING: Use the /noatime switch with caution. Do not use the /noatime switch on an NSS volume if the programs and scripts that are used to manipulate its data require access times to be updated. The program or script cannot work as designed, and performance can significantly decrease.

For example, the following programs are affected by using the /noatime switch:

- **NSS Compression:** Because the access time is not updated, the compression algorithm eventually considers that all of the files on the NSS volume are unused, and it compresses them. If a file is accessed multiple times in a specified time period, the compression algorithm cannot detect that the access occurred, and it does not decompress the often-used files. Every time a compressed file is accessed, the file must be uncompressed before giving the file to the user. When the file is closed, the uncompressed instance is discarded, and the file remains compressed. Thus, when you enable /noatime on an NSS volume where compression is enabled, you effectively break how compression works, and cause the read access performance of the NSS volume to decrease significantly.
- **Dynamic Storage Technology:** Both global policies and volume policies that rely on the access time cannot be enforced.
  - The "Shift Accessed Shadow Files" global parameter controls how files are automatically moved from the secondary storage area to the primary storage. A file is shifted if it is accessed a second time during a specified interval. If the access time is not recorded, the file is never shifted by the policy. You can use /noatime switch on an NSS volume when you use DST if you disable the "Shift Accessed Shadow Files" global parameter, and you do not use the "Last Time Accessed" as a filter for a volume policy. The other filters will work fine.
  - The "Time Stamp Restrictions" identifies which time stamps to use when applying the policy. A policy based on "Last Time Accessed" can be enforced only for files with access times recorded before you disabled the access-time updates.

A.22.1 Using noatime or atime at the Command Line

Issue the following commands in the NSS Console.

nss /atime=*volumename*

This option enables the updating of access time for both files and directories in a specified volume so that reading a file updates its access time. This is enabled by default.

nss /noatime=*volumename*

This option disables the updating of access time for both files and directories in a specified volume so that reading a file does not update its access time.

A.22.2 Using noatime in a Cluster Load Script

You can also use the `noatime` option when mounting an NSS volume in a OES Cluster Services cluster load script. The `atime` setting is enabled by default, so it is not necessary to specify it explicitly.

In the cluster load script, modify the `ncpcon mount` command for the volume:

```
exit_on_error ncpcon mount /opt="noatime" volumename=volume_id
```

When you create a new volume on a cluster-enabled pool, Cluster Services automatically assigns it a volume ID that is unique in the entire cluster and writes the value to the cluster resource load script for the pool. When you add the `/opt` option to volume's mount line in the load script, the volume ID is already part of the command.

For example, for a volume named VOL1 and a volume ID of 254, the commands would be:

```
mount /opt="noatime" VOL1 VOLID=254
```

```
exit_on_error ncpcon mount /opt="noatime" VOL1=254
```

A.22.3 Viewing the atime or noatime Setting

You can view the current setting for the `atime` attribute by using the `nss /volumes` command at the NSS Console.

`atime` attribute is enabled - Attribute is not displayed.

`atime` attribute is disabled - No Access Time is displayed.

A.23 noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab

NSS on OES supports the `O_NOATIME` option for the Linux `open(2)` command, and the `noatime` and `nodiratime` options for the `mount` and `nfsmount` command and the `/etc/fstab` file. These options have the same objective—that is, to prevent the access time from being updated unless the access involves a modification of a file's or directory's metadata or content.

- **noatime:** Disables the updating of access time for both files and directories so that reading a file does not update their access time (atime).
- **nodiratime:** Disables updating of access time when opening directories so that the access time is not modified when enumerating directories. This routine also checks that the object is a directory, which slows down the routine.

These options are useful for backup, news servers, and mail servers where the extra disk activity associated with updating the access time is not desired. Avoiding the writes associated with updating the access time can result in measurable performance gains.

IMPORTANT: Typically, you need to use only the `noatime` option so that atime is not updated for the accessed file and its directory when the file is accessed. To determine if the `noatime` and `nodiratime` options can help the performance of a particular application, refer to the documentation and best practices for that application.

For information about applying these options, see the following:

- Section A.23.1, “Linux open(2) Command,” on page 466
- Section A.23.2, “Linux mount Command,” on page 466
- Section A.23.3, “Linux nfsmount Command,” on page 467
- Section A.23.4, “Linux /etc/fstab File,” on page 467

A.23.1 Linux open(2) Command

By default, the `open` command updates the access time whenever a file is opened or a directory is accessed. The `O_NOATIME` option disables the updating of access time, so that reading a file does not update its access time. Using this option allows you to back up a volume without modifying the access times (`ATIME`) of its files.

The man page for the `open(2)` command defines the `O_NOATIME` option as follows:

O_NOATIME

(Since Linux 2.6.8) Do not update the file last access time when the file is read. This flag is intended for use by indexing or backup programs, where its use can significantly reduce the amount of disk activity.

For information about how to use the `O_NOATIME` option, see the man page for the Linux `open(2)` command by entering `man 2 open` at a terminal console prompt.

A.23.2 Linux mount Command

The `noatime` and `nodiratime` options for the `mount` command are available for all Linux file systems, including NSS.

IMPORTANT: Typically, you need to use only the `noatime` option so that atime is not updated for the accessed file and its directory when the file is accessed. To determine if the `noatime` and `nodiratime` options can help the performance of a particular application, refer to the documentation and best practices for that application.

To enable `noatime` or `nodiratime` options when mounting an NSS volume:

1. Open a terminal console on the server, then log in as the `root` user.
2. At the terminal console prompt, enter (all on the same line, of course):

   ```
   mount -t nssvol VOL vol_mountpoint -o name=volname,noatime
   ```

   or

   ```
   mount -t nssvol VOL vol_mountpoint -o name=volname,nodiratime
   ```

Replace *vol_mountpoint* with the mount point for the volume, such as `/media/nss/NSSV1`. Replace *volname* with the name of the volume, such as NSSV1.

For example, enter:

```
mount -t nssvol VOL /media/nss/NSSV1 -o name=NSSV1,noatime
```

This command mounts the volume NSSV1 with the `noatime` option so that the file and directory access times are not updated when a file is accessed but not modified.

A.23.3 Linux nfsmount Command

1. In YaST, click **Network Services > NFS Server > NFS Mount**.
2. Specify the volume, then enter

   ```
   rw,no_root_squash,sync,fsid=value,noatime
   ```

   For information about the other `nfsmount` options used here, see Section 19.16, “Exporting and Importing NSS Volumes for NFS Access,” on page 282.
3. Click **OK**.

A.23.4 Linux /etc/fstab File

The `noatime` and `nodiratime` options are available as mount options in the `/etc/fstab` file for all Linux file systems, including NSS. To enable the `noatime` and `nodiratime` options as default mounting options for a volume so they are in effect at boot time, modify the entry for the NSS volume in the `/etc/fstab` file.

1. Open the `/etc/fstab` file in a text editor.
2. Modify the entry for the NSS volume by adding `noatime` or `nodiratime` as options.

   For example, type

   ```
   volname vol_mountpoint nssvol noauto,rw,name=volname,noatime 0 0
   ```

   Replace *volname* with the name of the volume, such as NSSV1. Replace *vol_mountpoint* with the mount location of the NSS volume, such as `/media/nss/NSSV1`.

   For example (all on the same line, of course):

   ```
   NSSV1 /media/nss/NSSV1 nssvol noauto,rw,name=NSSV1,noatime 0 0
   ```
3. Save the file.
4. Reboot the server to apply the changes.

A.24 Opportunistic Locking Commands

The opportunistic locking is controlled by NCP Server. Use the NCP Server option OPLOCK_SUPPORT_LEVEL to manage oplocks for NSS volumes on OES. For more information, see “Using Opportunistic Locking for NCP File Handling”.

A.25 Pool Freeze and Thaw Commands

Use the commands in this section to temporarily freeze (quiesce) and thaw activity on a pool.

nss /PoolFreeze=*poolname*

Temporarily quiesces activity on the specified pool.

nss /PoolThaw=*poolname*

Resume activity on the specified pool that has previously been frozen.

A.26 Pool Management Commands

Enter the following commands to perform maintenance for NSS pools and volumes.

NOTE: You can execute some commands from NSSCON and some commands from both NSSCON and server console.

A.26.1 Pool Status

nss /LVScan=*poolname*

Available from NSSCON. Scans for logical volumes within the specified active pool.

nss /pools, or pools

Available from NSSCON and server console both. Shows all of the currently available NSS pools.

nss /ZLSSPoolIOErrors

Available from NSSCON. Shows the last 100 pool I/O errors reported from the block layer that have occurred since the server's last reboot. The block layer does not have many error codes, so the usefulness of the error may be limited. NSS stores some block layer errors in the `/var/log/messages` file. Look for `BIO_` in the log file to see if any pool I/O error messages are present.

A.26.2 PoolAuto Commands for Load Time

Use the pool commands in this section at load time. Any encrypted volumes on the pool cannot be automatically activated. Encrypted volumes remain deactive until you activate the volume manually and provide the password on the first activation after a reboot.

Place the PoolAuto commands in the `nsstart.cfg` file to make them persist across reboots. The file is in the `/etc/opt/novell/nss` directory.

The following commands are available only from NSSMU:

PoolAutoDisplay=<*poolname* | all>

Displays the pool's current load-time policies.

nss /PoolAutoActivate=<*poolname* | all>

Activates specified pools at load time.

nss /PoolAutoDeactivate=<*poolname* | all>

Leaves specified pools in the deactivated state at load time.

nss /PoolAutoMaintenance=<*poolname* | all>

Places specified pools in maintenance mode at pool load time.

nss /PoolAutoVerify=<*poolname* | all>

Verify the specified pool's physical integrity at startup time.

The following modifier commands can be used with the /PoolAuto commands to automatically handle pools of status type shared, corrupt, and questions.

nss </*PoolAuto_command*> [/IncludeType=*type* | OverrideType=*type*]

Use the IncludeType or OverrideType modifier commands to include or override pools of the specified status type for a given /PoolAuto... command. Possible status types are SHARED, CORRUPT, and QUESTIONS.

A.27 Pool Snapshot Commands

NSS pool snapshots are supported on OES 2 and later; however, there are no command line options available. You must use NSSMU to manage NSS pool snapshots. For general information about pool snapshots, see Chapter 18, "Managing NSS Pool Snapshots," on page 243. For an NSSMU for Linux quick reference on snapshots, see "Snapshots" in Table 10-11 on page 109.

A.28 Pool Verify and Rebuild Commands

For NSS volumes, use the RAVSUI utility to verify and rebuild pools. For more information about rebuilding pools, see Chapter 17, "Verifying and Rebuilding NSS Pools and Volumes," on page 233.

A.29 POSIX Permission Mask Command

nss /PosixPermissionMask=*mask*

Specify the octal mask to control which bits in the POSIX permissions (`drwxrwxrwx`) are allowed to be set. The octal digits correspond to directory, user, group, and other fields. By default, NSS sets the POSIX permissions to 0777.

IMPORTANT: NSS uses the OES trustee model to authenticate and give access to users, not the Linux ACLs and POSIX permissions.

The command applies to all NSS volumes on the Linux server. In a cluster environment, make sure that the setting is the same on all nodes. This command should normally be added in the `/etc/opt/novell/nss/nssstart.cfg` file so that it persists across reboots.

Example

For example, SSH requires that the permissions in the Other field be disabled. If you use NSS volumes for home directories and you want users to have SSH access to them, you must modify the POSIX permissions to 0770. The following command in the `/etc/opt/novell/nss/nssstart.cfg` file turns off all of the bits corresponding to the Other field:

`/PosixPermissionMask=0770`

The setting applies to all NSS volumes on the server. You must also Linux-enable users and enable SSH with Linux User Management

If the volume is shared in a cluster, make sure to add the command to the `nssstart.cfg` file on all nodes and to Linux-enable SSH on all nodes.

A.30 Quotas Commands

Use the commands in this section to manage quotas (space restrictions) for NSS pools and volumes.

- Section A.30.1, “Sys: Volume Quota Command,” on page 470
- Section A.30.2, “Directory Quotas Commands,” on page 470
- Section A.30.3, “User Quotas Commands,” on page 470

A.30.1 Sys: Volume Quota Command

nss /ChangeSysQuota=*size*

Lets you change the quota (in MB) for the `sys:` volume. Setting this value to zero sets the Quota to none and allows the `sys:` volume to grow to the size of the `sys` pool.

A.30.2 Directory Quotas Commands

nss /(No)DirectoryQuotas=*volumename*

Enables or disables the Directory Quotas attribute on the volume.

nss /FixDirectoryQuotas=*volumename*

Recomputes used space for directory quotas for the specified volume.

This process can take time to recalculate, depending on the number of directory quotas set on the volume. There are no interim messages to report status.

A.30.3 User Quotas Commands

nss /(No)UserSpaceRestrictions=*volumename*

Enables or disables the User Quotas attribute on the volume. After you enable quotas, use go to the **Storage > User Quotas** page in iManager to set quotas for users.

A.31 Read Ahead Blocks and Allocate Ahead Blocks Commands

NSS offers the Read Ahead Blocks command for tuning read performance, and the Allocate Ahead Blocks command for tuning write performance. You can enter the commands in the NSS Console.

- Section A.31.1, “Read Ahead Blocks,” on page 471
- Section A.31.2, “Allocate Ahead Blocks,” on page 471

A.31.1 Read Ahead Blocks

The Read Ahead Blocks parameter can be set differently on each NSS volume. It specifies the number of data blocks that NSS reads ahead for any open file on which read operations are ongoing in the specified server. The Read Ahead Blocks parameter is enabled by default and set at 16 blocks. To modify the value, you must set it from the command line using the `ReadAheadBlks` switch. You can also set the value from NSSMU in the volume properties.

The valid range for block count is 0 blocks to 1024 blocks, where a block count of zero (0) implies no read ahead.

The most efficient value for block count depends on your hardware. In general, we recommend a block count of 8 to 16 blocks for large data reads; 2 blocks for CDs, 8 blocks for DVDs, and 2 blocks for ZLSS.

Aggressive read ahead is optimal only for sequential access. As the number of concurrent connections to unique files increases, you should reduce the read-ahead block count.

nss /ReadAheadBlks=*volname:count*

Specify *VolName* as the name of the volume that you are setting the attribute for. Specify the *Count* to be the number of 4 KB blocks that you want to NSS to read ahead. The valid range for a block count is 0 blocks to 1024 blocks, where a block count of zero (0) implies no read ahead. However, 128 blocks is the practical maximum.

Read-ahead block counts higher than 128 can starve other system components for memory or buffers, which can impair performance or cause the system to hang. As the number of concurrent connections to unique files increase, you should reduce the number of read-ahead blocks.

Default: 16

Range: 0 to 1024 blocks, where 0=Off; Practical maximum: 128

A.31.2 Allocate Ahead Blocks

When applications write data to the file system, NSS allocates the blocks at the logical write time and the new data is cached in memory. At a later time, all cached blocks are grouped and are written to the disk in an optimal order based on the flush policy. AllocAheadBlocks helps applications and protocol servers that do small writes for moderate or large files so they have fewer transactions and the blocks on the disk are less fragmented. Having less fragmentation on disk substantially helps all further physical reads from the disk, because the disks do not need to use as much time in seeking.

Logical Write Time: When the application writes to NSS.

Physical Write Time: When NSS writes to the disk.

If the application is doing small writes NSS allocates blocks in small increments. Depending on the other parallel activities going on in the system, the blocks on disk could become fragmented, in spite of the attempts made by NSS to allocate these blocks in the same area.

Use the Allocate Ahead Blocks parameter for tuning write performance for all NSS volumes on the server.

nss /AllocAheadBlks=*value*

Sets the number of blocks to allocate ahead on writes.

Default: 0

Range: 0 to 63

For example, if most of the files that are created and extended are 64 KiB, AllocAheadBlocks should be set to 16 KiB (64 KiB / 4 KiB = 16) (a data block is 4 KiB bytes).

The default is set to zero because higher settings can slow down small file creation. For example, if AllocAheadBlks is set to 16, NSS allocates 16 data blocks. For a small file this is the only logical write. When the file is closed, NSS is forced to truncate the file to the correct size which slows down small file creation.

A.32 Salvage and Purge Commands

Use the commands in this section for tuning the purging processes for NSS volumes. For more information about managing salvage for NSS volumes, see Chapter 24, “Salvaging and Purging Deleted Volumes, Directories, and Files,” on page 351.

nss /(No)ImmediatePurgeOfDeletedFiles

Enables or disables files to be purged immediately upon deletion.

NSS volumes on the server can optionally use the salvage feature of NSS to save deleted files until space is needed. When you enable the Immediate Purge of Deleted Files parameter, it affects all volumes on the server. If the Salvage attribute is enabled for a volume, enabling this flag overrides it so that deleted files and directories are purged immediately.

Default: Disabled

nss /(No)Salvage=<*volumename* | all>

Enables or disables the ability to salvage of deleted files on volumes. *Volume* enables the Salvage command on the specified NSS volume on the specified server. *All* enables the Salvage command on all NSS volumes on the specified server.

nss /LogicalVolumePurgeDelay=*value*

The number of seconds before deleted logical volumes are purged. This allows time to reverse the deletion.

Default: 345600 (4 days)

nss /LogicalVolumePurgeDelayAfterLoad=*value*

The number of seconds after NSS loads before deleted logical volumes are purged. This allows time to pause autopurging.

Default: 7200

nss /LogicalVolumePurgeDelayAfterContinue=*value*

The number of seconds to delay purging a deleted logical volume after clicking Continue. After a volume starts to purge, it cannot be salvaged.

Default: 900

nss /PoolHighWaterMark=*poolname*:Percent

Purging begins in the salvage area when the pool's low watermark is reached, and continues until its high watermark is reached, or until there are no deleted files and volumes left to purge, whichever occurs first. Autopurging does not start again until free space again drops below the low watermark. Specify a given poolname or All to apply the setting to all pools.

The high and low watermarks must be at least 2% apart from each other.

Default: 20

Range: 2 to 100

nss /PoolLowWaterMark=*poolname*:Percent

Purging begins in the salvage area when the pool's low watermark is reached and continues until its high watermark is reached. When free disk space falls below a low watermark, NSS begins autopurging the salvage area. Specify a given poolname or All to apply the setting to all pools.

The high and low watermarks must be at least 2% apart from each other.

Default: 10

Range: 0 to 98

nss /SalvageSys

Lets you restore the `sys:` volume if you have deleted it (if it has not yet been purged).

nss /LVDeleteStatusBasic, or LVDeleteStatusBasic

Displays information about deleted logical volumes.

nss /LVDeleteStatusSalvageable, or LVDeleteStatusSalvageable

Displays information about salvageable logical volumes.

nss /PurgesObjectLimit

Limits the number of concurrent purges.

Default: 2000

Range: 1 to 100000

A.33 Security Equivalence Vector Update Commands

Use the Security Equivalence Vector (SEV) Update commands in the NSS Console utility (`nsscon`) to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors. Polling too frequently can impact performance. Polling too infrequently can cause delays in granting or restricting access to certain users. For more information about SEV, see Section 21.2, "Configuring the Security Equivalence Vector Update Frequency," on page 309.

nss /(No)SecurityEquivalenceUpdating

Enables or disables SEV updates to occur in the background in addition to updates that occur when the system reboots. If it is disabled, SEV updates occur only at system reboots.

To make it persistent, include the command in the `/etc/opt/novell/nss/nsstart.cfg` file.

Default: On (enabled)

Examples

To enable background updating, enter

```
nss /SecurityEquivalenceUpdating
```

To disable background updating, enter

```
nss /NoSecurityEquivalenceUpdating
```

nss /(No)eDirSecurityEquivalenceUpdating

Enables or disables eDirectory user SEV updates to occur in the background. If it is disabled, SEV updates occur only at system reboots.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: On (enabled)

Examples

To enable eDirectory user background updating, enter

```
nss /eDirSecurityEquivalenceUpdating
```

To disable eDirectory user background updating, enter

```
nss /NoeDirSecurityEquivalenceUpdating
```

nss /(No)ADSecurityEquivalenceUpdating

Enables or disables AD user SEV updates to occur in the background. If it is disabled, SEV updates occur only at system reboots.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: On (enabled)

Examples

To enable AD user background updating, enter

```
nss /ADSecurityEquivalenceUpdating
```

To disable AD user background updating, enter

```
nss /NoADSecurityEquivalenceUpdating
```

nss /(No)OptimizeSEVRefresh

Enables SEV refresh only for those connections that are used within the default update interval. To get the default update interval, see the `UpdateEdirSecurityEquivalenceInterval`, `UpdateADSecurityEquivalenceInterval`, and `UpdateSecurityEquivalenceInterval` parameters.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: Off (disabled)

Examples

To enable optimized SEV refresh, enter

```
nss /OptimizeSEVRefresh
```

To disable optimized SEV refresh, enter

```
nss /NoOptimizeSEVRefresh
```

nss /UpdateSecurityEquivalenceInterval=*value*

Sets the SEV update interval to the specified value in seconds. At the end of the elapsed time, NSS requires updated SEVs from eDirectory and AD.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: 7237 (2 hours 37 seconds)

Range: 300 (5 minutes) to 7776000 (90 days).

nss /UpdateEdirSecurityEquivalenceInterval=*value*

Sets the eDirectory SEV update interval to the specified value in seconds.

Default: 600 (10 minutes)

Range: 300 (5 minutes) to 7776000 (90 days).

nss /UpdateADSecurityEquivalenceInterval=*value*

Sets the AD SEV update interval to the specified value in seconds.

Default: 1800 (30 minutes)

Range: 300 (5 minutes) to 7776000 (90 days).

nss /ForceSecurityEquivalenceUpdate

Forces the SEV update to occur immediately for all users in the NSS file system. Use this command if you modify a user's access control settings in eDirectory and want those changes to be reflected immediately in the user's active SEV for this server.

This command is invalid if used in the `/etc/opt/novell/nss/nssstart.cfg` file.

A unique abbreviation such as

```
nss /ForceS
```

also works.

/UserType

Specifies the user type for `ListConnections`. The valid values are AD and Edir. This parameter is used only with `ForceSecurityEquivalenceUpdate` parameter.

/UserFDN

Specifies the user FDN for force SEV update. This parameter is used only with `ForceSecurityEquivalenceUpdate`, `ForceEdirSecurityEquivalenceUpdate`, and `ForceADSecurityEquivalenceUpdate` parameters.

ForceSecurityEquivalenceUpdate

Forces the user security equivalence background updating to start immediately. Use this command if you modify a user's access control settings in eDirectory and AD, and want those changes to be reflected immediately in the user's active SEV for this server. You can update the SEV only for eDirectory or AD users using `/UserType` switch. Also, you can update the SEV for a single eDirectory or AD user using the `/UserFDN` switch.

ForceEdirSecurityEquivalenceUpdate

Forces the user security equivalence update for eDirectory user. You can update a single eDirectory user using the `/UserFDN` switch.

ForceADSecurityEquivalenceUpdate

Forces the user security equivalence update for AD user. You can update a single AD user using the `/UserFDN` switch.

A.34 Sendfile API Support Command

nss /(No)SendfileSupport

Enable or disable support for the sendfile() API.

Default: On

A.35 Status Commands

Enter the following commands in a server console to show the status of various NSS parameters.

CompScreen

Displays the NSS volume compression statistics on the compression screen.

nss /pools, Pools

Lists all of the NSS pools that are currently available on the server.

PoolsAutoDisplay

Displays load-time policies for pools on the server.

nss /status, Status

Lists the current NSS status information.

nss /volumes, Volumes

Lists all of the NSS volumes that are currently mounted and active, including the `_admin` volume.

VolumesAutoDisplay

Displays load-time policies for volumes on the server.

SpaceInformation

Lists the amount of space on active pools and their associated volumes.

ListFreeSpace

Lists the amount of available space that has not been assigned to a pool.

nss /ErrorCode=*code*

Translates and describes the specified error code.

Modules

Lists the providers, loadable storage subsystems, and semantic agents.

Version

Displays the version information for NSS.

PoolMediaVersion

Lists the media version of all the active pools. For example, if the media version of a pool is 44.03, 44 represents the major media version number, and 03 represents the minor media version number. NSS32 represents a 32-bit pool and NSS64 represents a 64-bit pool.

A.36 Visibility Rebuild Command

You might need to rebuild the visibility list in order to address problems where the computed value does not equal the stored value for the visibility lists. For example, if the `dmptrust volumename` command reports unknown trustees or many mismatched user GUIDs, you might need to run a visibility rebuild for the NSS volume.

WARNING: The visibility rebuild process can be destructive. Users who could see directories before might not be able to afterwards. Run this operation only as required. Do not use visibility list rebuilds as a regular maintenance tool.

- Section A.36.1, “Description,” on page 477
- Section A.36.2, “Syntax,” on page 478
- Section A.36.3, “Additional Information,” on page 478

A.36.1 Description

When you perform a visibility rebuild, the system first deletes all current entries in the visibility list. Then, in a second pass, the system attempts to rebuild the visibility list for assigned trustees. The numbers you see at the conclusion of the rebuild give the following information:

Parameter	Description
Objects examined	Indicates the total number of file system objects looked at (a total of files and directories, plus special file system beasts).
Objects cleaned	Indicates the number of directories where visibility information was removed during the first pass.
Overflow objects removed	Indicates the number of visibility overflow objects removed during the first pass.
Trustees re-added	Indicates the number of trustees found on the volume and re-added to visibility lists. Although this number is non-zero, it doesn't mean problems were fixed or resolved. Instead, the number indicates the number of trustees found and included in the visibility list (whether they were there before the rebuild started or not).

After you run a visibility rebuild, make sure you run the visibility check again. If there are still errors, you must examine your trustees for problem before running a visibility rebuild again.

A.36.2 Syntax

nss /VisibilityRebuild=*volumename*

Rebuild the authorization visibility lists for an NSS volume.

A.36.3 Additional Information

For information about checking, repair, and troubleshooting the visibility list for NetWare, see *NetWare 6 Trustee Rights: How They Work and What to Do When All Goes Wrong* (http://support.novell.com/techcenter/articles/ana20030202.html) in *Novell AppNotes* (2003, February 1).

A.37 Volume Management Commands

- Section A.37.1, “Volumes Command,” on page 478
- Section A.37.2, “Volume Activity Commands,” on page 479
- Section A.37.3, “Encrypted Volume Activity Commands,” on page 480
- Section A.37.4, “VolumeAuto Commands for Load Time,” on page 481

A.37.1 Volumes Command

NSS provides the `volumes` command and `/volumes` option for viewing a list of the currently mounted volumes, their status, and the attributes for NSS volumes. To view which attributes are currently set for a volume, enter

```
nss /volumes
```

You can also use enter the `volumes` command to get the same output.

The `volumes` utility for NCP provides additional information about the mounted volumes on a Linux server, such as its Linux path. For information, see Section B.11, “volumes (NCP Console Utility),” on page 510.

For example, the NSS `volumes` command outputs state and attributes information in a tabular format:

```
     Volume Name            State                Attributes
----------------------  -----------  ---------------------------------
_ADMIN                  ACTIVE       Hardlinks
                                     AD Enabled
DATA1                   ACTIVE       Salvage
                                     Trustee Index
DATA2                   ACTIVE       Salvage
                                     Compression
                                     User Space Restrictions
                                     Directory Quotas
                                     Migration
                                     Modified File List
                                     Immediately Flush Files On Close
                                     AD Enabled
                                     Trustee Index
VOL1                    ACTIVE       Salvage
                                     AD Enabled
                                     Trustee Index
VOL2                    ACTIVE       Salvage
```

The following volume attributes are displayed:

Attribute	For Information
Compression	Section A.6, “Compression Commands,” on page 444
Data shredding	Section A.7, “Data Shredding Commands,” on page 447
Directory quotas	Section A.30.2, “Directory Quotas Commands,” on page 470
Encryption	Section A.37.3, “Encrypted Volume Activity Commands,” on page 480
Hard links	Section A.13, “NSS Media Upgrade Commands,” on page 452
Migration (for near-line storage support)	Section A.18, “Migration Support Commands for Near-Line Storage,” on page 462
Modified File List (MFL)	Section A.19, “Modified File List (MFL) Commands,” on page 462
Salvage	Section A.32, “Salvage and Purge Commands,” on page 472
User quotas	Section A.30.3, “User Quotas Commands,” on page 470
AD Enabled	“Volume AD-enabling” on page 454
Trustee Index	“Trustee Index Media” on page 455

A.37.2 Volume Activity Commands

nss /ExtendMac=*volumename*

Enable extended Macintosh name space on the specified NSS volume.

nss /ForceActivate=*volumename*

Forces an NSS volume to become active. For encrypted NSS volumes, this command cannot force an activation unless the volume has been previously activated with a password on the first activation after a reboot.

nss /ForceDeactivate=*volumename*

Forces an NSS volume to the deactive state. Does not prompt for open files.

nss /VolumeActivate=*volumename*

Activates the specified NSS volume.

nss /VolumeDeactivate=*volumename*

Deactivates the specified NSS volume.

nss /VolumeMaintenance=*volumename*

Places a specified volume into maintenance mode. Volumes can be put in maintenance mode, but maintenance occurs only at the storage pool level.

mount *volume_name*

Mount the specified unencrypted NSS volume or an encrypted NSS volume that has been previously activated with its password. If it has not been previously activated, it returns an error message, requesting more information.

mount all

Mount all unencrypted NSS volumes and all encrypted NSS volumes that have been previously activated with their passwords. Encrypted NSS volumes that were not previously activated return error messages, requesting more information.

A.37.3 Encrypted Volume Activity Commands

Use the commands in this section to display volume status and to activate, mount, deactivate, or dismount encrypted NSS volumes.

You must enter a password the first time the volume is activated or mounted following a system reboot. Thereafter, other environmental security and authentication measures control access to user data.

IMPORTANT: Use NSSMU to mount encrypted volumes the first time after a server reboot. Thereafter, you can use the Linux `mount` command.

You cannot use wildcard commands, such as `nss /VolumeAutoActivate`, to activate encrypted NSS volumes.

You cannot use the wildcard option of All as the volume name for volumes where the password has not previously been provided. Until an encrypted volume is activated with its password following each system reboot, the All option does not find the volume and does not execute the command. The system returns an error message.

nss /activate=*volume_name*

Activate the specified unencrypted NSS volume.

On Linux, this command cannot be used to activate encrypted NSS volumes.

nss /activate=all

Activate all unencrypted NSS volumes. On Linux, this command cannot be used to activate encrypted NSS volumes.

nss /volumeactivate=*volume_name*

Activate the specified unencrypted NSS volume. If you are prompted for it, enter the encryption password. The password is required only on the first activation following a system reboot.

On Linux, this command cannot be used to activate encrypted NSS volumes.

nss /volumes

View the status of an encrypted and unencrypted NSS volumes. The encrypted volume returns a status of Encrypted.

A.37.4 VolumeAuto Commands for Load Time

Use the following command to view the volume's current load-time policies.

VolumeAutoDisplay=*volumename*

Displays the volume's current load-time policies.

Use the following commands in the `nssstart.cfg` file to control which volumes are active at load time. You cannot use these commands for encrypted NSS volumes. You must use NSSMU to activate the volume on the first time after restart so you can provide the password.

nss /VolumeAutoActivate=*volumename*

Activates the specified volume at load time.

nss /VolumeAutoDeactivate=*volumename*

Deactivates the specified volume at load time.

A.38 ZID Commands

Use the commands in this section to manage the file numbering, or ZIDs, of files on an NSS volume.

nss /ZIDNameSpace=*namespace*

Specify the name space (DOS, Long, Macintosh, or UNIX) the command `/ZIDToFileName` should use.

nss /ZIDtoFilename=*ZIDnumber*

For a specified ZID, reports the file's full path and filename for a given volume and name space. Use only with `/ZIDVolumeName` and `/ZIDNameSpace` to provide context for the command.

nss /ZIDVolumeName=*volumename*

The volume name the command `/ZIDToFileName` should use.

/(No)ReZID

Use this option only with the pool rebuild options in the `ravsui` utility to enable or disable the rebuild to reZID the volume(s) in the pool that is being rebuilt.

Default: Off

Range: On or Off

Examples

For guidelines and instructions for how to use the ReZID option with pool rebuild commands, see Section 17.3, “ReZIDing Volumes in an NSS Pool,” on page 239.

nss /ForceVolumeZID64Mode=*volumename*

Use this option to set the ZID mode of a volume to ZID64. This setting allows NSS to create files or folders beyond the 4 billion limit. If a volume is configured with `Zid64` mode, then NSS allows creating the files or folders up to 8 trillion ZIDs.

B NSS Utilities

This section details the syntax and options for the following OES Storage Services utilities for Open Enterprise Server.

- Section B.1, “attrib,” on page 483
- Section B.2, “compfix,” on page 486
- Section B.3, “metamig,” on page 489
- Section B.4, “nsscon,” on page 493
- Section B.5, “nssmu,” on page 494
- Section B.6, “nssupdate,” on page 495
- Section B.7, “ravsui,” on page 496
- Section B.8, “ravview,” on page 499
- Section B.9, “refreshids,” on page 503
- Section B.10, “rights,” on page 504
- Section B.11, “volumes (NCP Console Utility),” on page 510
- Section B.12, “nsssettings,” on page 511
- Section B.13, “nssquota,” on page 511
- Section B.14, “nssraid,” on page 514
- Section B.15, “ncsinit,” on page 514
- Section B.16, “nsschown,” on page 515
- Section B.17, “map-users,” on page 518
- Section B.18, “user-rights-map,” on page 518
- Section B.19, “sputil,” on page 518

B.1 attrib

Use the Attribute (`attrib`) utility to set NSS file system directory and file attributes.

B.1.1 Syntax

`attrib [options] [filename]`

If both the set and clear options are selected, the clear option is completed before the set option. If the filename is not specified, the operation is completed on the current directory.

B.1.2 Options

Option	Description
`-s, --set=ATTRIBUTES`	Set the attributes on the file.
`-c, --clear=[ATTRIBUTES | all]`	Clear the attributes on the file.
`-D, --dst`	Option to set or clear the attributes on DST primary and shadow volume. This option must be used with `--set` or `--clear`. **NOTE:** Beginning with OES 2018 SP3, the `-D` option is set by default. Any operation performed on the DST primary volume is also applied to the shadow volume.
`-p, --no-dst`	Option to list, set or clear the attributes on the specified volume.
`-l, --long`	Displays a long version of the file attributes.
`-q, --quiet`	Does not display any normal output.
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the ATTRIB help screen.
`-S, --softlink`	Do not follow link option.
`-r, --recursive`	Set the attributes recursively on the directory.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.

B.1.3 Attributes

Multiple attributes are separated with commas.

Attribute	Description	Applies to Files	Applies to Directories
`aa`	Attribute Archive identifies that a file's metadata has been modified since the last backup. This attribute is assigned automatically.	Yes	No
`all`	All (used only for the Clear option) represents all attributes that can be modified.	Yes	Yes
`ar`	Archive identifies files that have modified content since the last backup. This attribute is assigned automatically.	Yes	No
`cc`	Cannot Compress (status display only) displays if the file cannot be compressed because of limited space savings.	Yes	No

Attribute	Description	Applies to Files	Applies to Directories
ci	Copy Inhibit prevents users from copying a file. This attribute overrides the Read and File Scan trustee rights. This attribute works only for clients using Macintosh operating systems to access NSS volumes on NetWare.	Yes	No
cm	Compressed (status display only) indicates whether the file is currently stored in compressed format.	Yes	No
dc	Don't Compress keeps data from being compressed. This attribute overrides settings for automatic compression of files not accessed within a specified number of days.	Yes	No
di	Delete Inhibit prevents users from deleting a directory or file. This attribute overrides the file system trustee Erase right. When Delete Inhibit is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this attribute to allow the directory or file to be deleted.	Yes	Yes
ex	Execute indicates program files, such as .exe or .com files.	Yes	No
hi	Hidden hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
ic	Immediate Compression sets data to be compressed as soon as a file is closed. If applied to a directory, every file in the directory is compressed as each file is closed. The files in the specified directory are compressed as soon as the operating system can perform the operation after the file is closed. This does not apply to the directory's subdirectories and the files in them.	Yes	Yes
ip	Immediate Purge flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered.	Yes	Yes
ln	Link (status display only) indicates a symbolic link (soft link).	Yes	No
mg	Migrated (status display only) displays if the file or directory is migrated to near-line media.	Yes	Yes
mi	Migrate Inhibit prevents directories and files from being migrated from the server's disk to a near-line storage medium.	Yes	Yes
ri	Rename Inhibit prevents the file or directory name from being modified.	Yes	Yes
ro	Read Only prevents a file from being modified.	Yes	No
sd	Subdirectory (status display only) indicates that the entry is a directory, not a file.	No	Yes
sh	Shareable allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No

Attribute	Description	Applies to Files	Applies to Directories
sy	System hides the directory or file so it does not appear in a file manager or directory listing. This attribute is normally used with system files.	Yes	Yes
tr	Transactional allows a file to be tracked and protected by the Transaction Tracking System (TTS).	Yes	No
vo	Volatile indicates that a file can change without being written to so that opportunistic locks cannot be set on it.	Yes	No

B.1.4 Example

```
attrib /designs/topsecret -c=all -s=ro,di
```

This command clears all attributes, then sets Read Only and Delete Inhibit on the `/designs/topsecret` file.

```
attrib /designs/topsecret -c=all -s=ro,di -D
```

If `/designs/topsecret` is a DST primary volume with shadow volume path (`/designs/secret`), this command clears all attributes, then sets Read Only and Delete Inhibit on `/designs/topsecret` and `/designs/secret` files.

```
attrib /designs/topsecret -c=all -s=ro,di -p
```

This command clears all attributes, then sets Read Only and Delete Inhibit on `/designs/topsecret` files. The `/designs/topsecret` is a DST primary volume path.

B.2 compfix

- Section B.2.1, “Prerequisite for Computing Compression Statistics,” on page 487
- Section B.2.2, “Syntax,” on page 487
- Section B.2.3, “Parameters,” on page 487
- Section B.2.4, “Help Options (HOPTION),” on page 487
- Section B.2.5, “General Options (GOPTION),” on page 487
- Section B.2.6, “Volume-Level Options (VOPTION),” on page 488
- Section B.2.7, “File-Level Options (FOPTION),” on page 488
- Section B.2.8, “Examples,” on page 488

Use the COMPFIX utility to repair compression information for compressed NSS volumes or to clear the Cannot Compress attribute for files in the compressed NSS volume. This tool can help identify which compressed files are corrupted and can be fixed; however, not all corrupted compressed files are fixable.

B.2.1 Prerequisite for Computing Compression Statistics

Before using the COMPFIX utility to compute compression statistics, make sure that your volume is in ACTIVE mode in order for statistics to be computed.

B.2.2 Syntax

Run the COMPFIX utility (`/opt/novell/nss/sbin/compfix`) from the terminal console prompt.

```
compfix [HOPTION]
compfix [GOPTION]... [VOPTION] VOLUMENAME
compfix [GOPTION]... [FOPTION] FILENAME
```

Mandatory arguments to long options are also mandatory for short options.

B.2.3 Parameters

Parameter	Description
VOLUMENAME	Specifies the volume name of the compressed volume you want to repair, such as VOL1.
FILENAME	Specifies the full path to the individual compressed file that has compression errors you want to repair, including its filename and extension. The filename must an absolute path. For example: */media/nss/VOL1/dir1/dir2/myfile.xxx*

B.2.4 Help Options (HOPTION)

Option	Description
`-h, --help`	Displays help information and exits.
`-v, --version`	Displays version information and exits.

B.2.5 General Options (GOPTION)

Multiple general options can be selected.

Option	Description
`-H, --no-header`	If this option is specified, COMPFIX does not validate compression headers. Use this option on volumes restored from scan files that do not have user data blocks.
`-p, --logpath=`*`path`*	Specifies the location of the log file. The default location is at the root of the compressed volume you are analyzing or fixing. **Default:** `./compfix.log`

B.2.6 Volume-Level Options (VOPTION)

Only one volume-level option can be selected.

Option	Description
`-D, --delete-all`	Deletes all non-fixable compressed files on the specified volume.
`-F, --fix-all`	Fixesall repairable compressed files on the specified volume.
`-L, --list-all`	Lists all problematic compressed files on the specified volume.
`-S, --fix-stats`	Fixes volume compression-related statistics. For accurate results, make sure the volume is in maintenance mode before issuing this command.
`-C, --clear-all`	Clears the Cc (Cannot_Compress_File) attribute for all files on the specified volume.

B.2.7 File-Level Options (FOPTION)

Only one file-level option can be selected.

Option	Description
`-b, --background`	Checks if the specified file is eligible for the next background compression process.
`-d, --delete`	Deletes the specified compressed file if it is non-fixable.
`-f, --fix`	Tries to fix the specified file's compression-related problem.
`-l, --list`	Lists the specified file's compression-related information.
`-c, --clear`	Clears the specified file's Cc (Cannot_Compress_File) attribute.

B.2.8 Examples

The following table illustrates typical uses of the COMPFIX utility. The commands in the left column should be written all on the same line, of course.

Command	Description
`compfix --fix-stats VOL1`	Fixes compression statistics for the specified volume, VOL1. Log the results in the default location of `./compfix.log`.
`compfix --list-all VOL1 --logpath=/var/log/compfix.log`	Lists all corrupted compressed files on the specified volume, VOL1. Log the results in the specified location of `/var/log/compfix.log`.
`compfix -f /media/nss/VOL1/dir1/dir2/myfile.xxx`	Fixes an individual compressed file, `myfile.xxx`. Log the results in the default location of `./compfix.log`.
`compfix -F VOL1 --logpath=/var/log/compfix.log`	Fixes all fixable corrupted compressed files on the specified volume, VOL1. Log the results in the specified location of `/var/log/compfix.log`.
`compfix -b /media/nss/VOL1/dir1/dir2/myfile.xxx`	Checks whether an individual compressed file, `myfile.xxx`, is eligible for the next background compression process. Log the results in the default location of `./compfix.log`.
`compfix -C VOL1 --logpath=/var/log/compfix.log`	Clears the Cannot Compress (Cc) attribute for files in the specified volume, VOL1. Logs the results in the specified location of `/var/log/compfix.log`.

B.3 metamig

The NSS File System Metadata Migration Utility (METAMIG) for Linux allows you to save and restore NSS file system trustee, user quota, and directory quota metadata for eDirectory and AD (Active Directory) users.

- Section B.3.1, “Syntax,” on page 489
- Section B.3.2, “Arguments,” on page 490
- Section B.3.3, “Options,” on page 490
- Section B.3.4, “Examples,” on page 492

B.3.1 Syntax

METAMIG is located in the `/opt/novell/nss/sbin/metamig` directory.

```
metamig [OPTIONS]

metamig save volume [SOPTIONS]

metamig restore volume [ROPTIONS]
```

B.3.2 Arguments

The first argument indicates the action to be taken on the specified NSS volume. Possible actions are `Save` and `Restore`.

Argument	Description
`save`	Saves the indicated metadata to `stdout`.
`restore`	Restores the indicated metadata to `stdin`.

The second argument specifies the NSS volume name to be saved or restored.

The third argument specifies the path to a file. This is the file to be created on save, or the file to be restored from on restore.

B.3.3 Options

Several option types are available:

- “General Options” on page 490
- “SOptions (Save)” on page 490
- “ROptions (Restore)” on page 491
- “MASK” on page 492
- “TYPE” on page 492

General Options

The following options are general options available to actions related to save or restore.

Option	Description
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the help screen.

SOptions (Save)

The following options are options available to actions related to save.

Option	Description
`-m, --meta=MASK`	The types of metadata to be saved. By default, all the types of metadata are included and all the trustees are retained. For information, see MASK.
`-u, --usertype=TYPE`	Saves the metadata based on the eDirectory or AD user. If this option is not specified, both eDirectory and AD users are included by default. For information, see TYPE. **NOTE:** The option "-u ad" cannot be used with the option "-n".
`-p, --path`	Exports the settings of all the files under a given path.
`-n, --ncp`	Saves the trustee metadata from the NCP Trustee database instead of parsing the volume to generate the data. Use this option only if you are confident that the NCP Trustee database is available and current. For example, if the NCP Server has been turned off and its database is not yet resynchronized with the volume, do not use this command option until the database is again current.

ROptions (Restore)

The following options are options available to actions related to restore.

Option	Description
`-a, --actions`	Display all actions taken
`-m, --meta=mask`	The types of metadata to be restored. By default, all the types of metadata are included and all the trustees are retained. For information, see MASK.
`-f, --filter=regexp`	A filter that restores only files and directories that match the specified regular expression. Use a regular expression to specify one or more files and directories to be restored. For example, to set the criteria to restore only files with names that start with the letter “a”, use this option: --filter=.*/a.* However, if you have used the NCP trustee database to save the metadata, then use this option: --filter=.*\\a.* to set the criteria to restore only files with names that start with the letter “a”. Please refer to a programming textbook or search the Internet for information about how to construct regular expressions.
`-u, --usertype=TYPE`	Restores the metadata based on the eDirectory or AD user. If this option is not specified, both eDirectory and AD users are included by default. For information, see TYPE. **NOTE:** The option "-u ad" cannot be used with the option "-n".
`-t, --tree=treename`	If this value is specified, this setting overrides the saved directory treename.

Option	Description
`-n, --ncp`	Builds a new NCP trustee file from trustee data. This automatically disables restoration of quotas.
`-d, --details`	Displays all actions taken.
`-w, --inputfilefromnetware`	Specify this option if the input file is generated by TRUSTEE.NLM on the NetWare 6.5 SP8 server.
`-r, --relativepathprefix`	Specifies the reference location of the OES server for the relative path, if the input file is generated by TRUSTEE.NLM on NetWare server with /R switch. TRUSTEE.NLM /R option puts relative path for file in its output.

MASK

The mask is a string of characters with each character representing a type of NSS file system metadata. Use the mask to specify values for the meta parameter in SOptions (Save) and ROptions (Restore). If no mask is specified, only t, u and d are considered as the default parameters.

Option	Description
`t`	Trustees
`u`	User quotas
`d`	Directory quotas
`a`	All metadata
`r`	Removes unknown trustees from the filesystem. This works only for save and not for the restore operations.

TYPE

The type is a string representing the different user type. Use the type to specify values for the usertype parameter in SOptions (Save) and ROptions (Restore).

Option	Description
`edir`	eDirectory users
`ad`	Active Directory users

B.3.4 Examples

To save the user quota data and directory quota data for a volume called `VOL1` in the `/backup/volquotas` file, enter

```
metamig save VOL1 -m ud >/backup/volquotas
```

To restore the user quota data from the file `/backup/volquotas` to `VOL1`, enter

```
metamig restore VOL1 -m u </backup/volquotas
```

To restore the trustee data from the file /backup/trustees, enter

```
metamig restore vol1 -m t -r dir1/dir2 -w -t TREENAME </backup/trustees
```

If trustees are backed up at a volume level using trustee.nlm with /R switch and all the source volume data is copied to the directory /media/nss/<volume>/dir1 on target volume, then -r should be dir1. If all the source volume data is copied to the root of the target volume /media/nss/<volume> then -r should be "/" or ".".

```
metamig save NSSVOL > unfiltered.xml
```

This command exports the setting of all the files under the volume NSSVOL.

```
metamig -p dir1 save NSSVOL > filtered.xml
```

This command exports the settings of all the files under the dir1 directory only

```
metamig save VOL1 -m a -u ad >/backup/adtrustees
```

This command saves all the metadata for AD users.

```
metamig restore VOL1 -m t -u edir </backup/trustees
```

This command restores the trustee data for eDirectory users.

B.4 nsscon

The NSS Console (NSSCON, nsscon) utility for OES provides a command line interface in a console environment familiar to NetWare administrators. Use it to issue NSS commands and to monitor NSS activity through console messages.

Start the nsscon utility, then enter the usual NSS commands from the nsscon prompt. You can issue any NSS command that is valid for use at the nsscon command prompt. For information about NSS commands, see Appendix A, “NSS Commands,” on page 439.

NOTE: The NSS command line utility (nss) is enhanced to support all the NSS commands that are supported by nsscon utility.

The Linux install creates symlinks in the /opt/novell/nss/sbin folder for common NSS utilities, including nsscon. Symlinks allow the path to the nsscon to become part of the root user’s path, which allows you to run it by entering nsscon at the system prompt.

The NSSCON utility uses a device file (/dev/nsscmd), which is set up to allow access only for the root user. Thus, only root can run nsscon. If you want to give access to a group of local users to run nsscon, use the chmod command on /dev/nsscmd to change the POSIX permissions for that group.

- Section B.4.1, “Adding /opt/novell/nss/sbin to the PATH Environment Variable,” on page 494
- Section B.4.2, “Starting nsscon,” on page 494
- Section B.4.3, “Using nsscon in a Script,” on page 494

B.4.1 Adding /opt/novell/nss/sbin to the PATH Environment Variable

You can add `/opt/novell/nss/sbin` to the PATH environment variable:

1. At a shell prompt, log in as the `root` user.
2. From a Bash shell, set the path with the command

   ```
   export PATH=$PATH:/opt/novell/nss/sbin
   ```

   This allows you to run nsscon by entering `./nsscon` at the system prompt.

B.4.2 Starting nsscon

1. At a shell prompt, log in as the `root` user.
2. Use one of the following methods to start NSSCON:
   - At a shell prompt, load NSSCON when its path is symlinked by entering

     ```
     nsscon
     ```

   - At a shell prompt, load NSSCON by its absolute pathname by entering

     ```
     /opt/novell/nss/sbin/nsscon
     ```

   - At a shell prompt, load NSSCON when its path is in the PATH environment variable by entering

     ```
     ./nsscon
     ```

B.4.3 Using nsscon in a Script

Only one instance of `nsscon` can be run at a time. If `nsscon` is already running when a script tries to run it, `nsscon` returns an error.

To work around this issue, you can send NSS commands directly to NSS via `nss` utility.

For example, if you use a script to put pools into maintenance, use the following syntax:

`nss /PoolMaintenance=`*`mypool`*

This causes NSS to place MYPOOL into maintenance state.

If `nsscon` is running, then the output of your command is displayed by `nsscon` immediately. Otherwise, the output is held by NSS until `nsscon` is run. In OES 2015, NSS holds 400K worth of output before starting to throw the oldest away. In OES 1, NSS holds only 32K of output before wrapping output.

B.5 nssmu

The NSS Management Utility (NSSMU) is a server-based tool that allows you to manage disks, software raids, pools, volumes, and snapshots for the NSS file system. For information, see Section 10.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 108.

B.6 nssupdate

The NSS Update (`nssupdate`) utility is used to resize a pool to a larger size so that it can consume contiguous free space that follows the existing pool on a device.

You do not need to run this utility if you increase the size of a pool by using standard NSS management tools. When you work with the NSS Management Utility (NSSMU), the NLVM command line utility, or the Storage plug-in for NetIQ iManager to manage NSS pools and volumes, NSS automatically makes any necessary changes to the underlying structure of the pool.

You can use this tool to manually resize a pool if you are using the NSS file system on a device that is managed by a volume manager other than NLVM, such as Linux Volume Manager 2 (LVM2). After you have performed all steps to increase the size of the LVM2 device and partitions by using Linux tools, use the NSS Update utility to let NSS know to expand the pool size to the desired new size (specified in bytes).

B.6.1 Syntax

`nssupdate -pool` *`poolName`* `-size` *`sizeInBytes`* `[-shared | -notshared]`

Issue this command from a terminal console prompt as the `root` user.

B.6.2 Options

-pool *poolname*

Specifies the name of the pool you want to resize.

-size *sizeInBytes*

Specifies the new maximum size of the pool in bytes.

The value for sizeInBytes cannot exceed the actual size of the device. You can enter any value larger than the pool's current size, up to the size of the device. The space you designate must already be free for consumption by the pool. Make sure that you understand exactly which space is free on the device so that you do not inadvertently overwrite any metadata stored at the end of the device. The pool begins at the same sector location as it currently does, and the extension is based on the space that follows its current end location on the device.

[-shared | -notshared]

Sets the share state of the pool. The -shared option sets the share state to **Shareable in a Cluster** so that the pool can be shared in a cluster environment that is using OES Cluster Services (NCS) for Linux. The -unshared option sets the share state to **Not Shareable**.

These options are intended to be used when you are using NSS pools with OES Cluster Services clusters. This requires that you use NSS partitions to create the pool. Use NSSMU, the NLVM command line utility, or the Storage plug-in to NetIQ iManager to set the device as shared and to manage the pool.

IMPORTANT: The shared state is not viable for NSS on pools created on non-NSS partitions.

B.6.3 Example

Open a terminal console, then log in as the `root` user to run this command.

`nssupdate -pool puserdata -size 2147483648`

Resizes the pool named `puserdata` to 2 GB (where 1 GB is 1024E3 (1024^3) bytes or 1,073,741,824 bytes).

B.7 ravsui

Use the Rebuild and Verify Simple User Interface (RAVSUI) utility to rebuild or verify an NSS pool that is in a maintenance state. You must log in as the `root` user to run this utility. You must place the pool in maintenance mode before starting the rebuild or verify process.

B.7.1 Syntax

`/opt/novell/nss/sbin/ravsui`

`ravsui [OPTION]... [ROPTION]... rebuild` *`poolname`*

`ravsui [OPTION]... [VOPTION]... verify` *`poolname`*

Replace *`poolname`* with the name of the pool you want to rebuild or verify, such as `POOL1`. Poolnames are case sensitive.

B.7.2 Arguments

The first mandatory argument specifies the action to be performed as rebuild or as verify.

- The rebuild action checks the integrity of the data in the pool and rebuilds the pool. A rebuild process can take up to several hours, depending on the size of the pool. The rebuild argument can be combined with one or more OPTION and ROPTION options.
- The verify action checks the integrity of the data in the pool; it does not perform the repair. A verify process can take several minutes, depending on the size of the pool. The verify argument can be combined with one or more OPTION and VOPTION options.

The second mandatory argument *`poolname`* is the target of the action. Replace *`poolname`* with the name of an NSS pool to be rebuilt or verified. Poolnames are case sensitive.

B.7.3 Options

This section describes the OPTION, ROPTION, and VOPTION options available for the RAVSUI (`ravsui`) utility. Mandatory arguments for long options are also mandatory for short options.

- “OPTION” on page 497
- “ROPTION” on page 497
- “VOPTION” on page 498

OPTION

General options can be used for both rebuild and verify actions.

Option	Description
`-a, --attach`	Attach to a rebuild or verify that it is running.
`-D, --log-kernel=MASK`	Controls the amount of log output from the kernel. **Default:** 0x70
`-d, --log-application=LEVEL`	Controls the amount of log output from the application. **Default:** 0x60
`-h, --help`	Displays this help information and exits.
`-P, --path=PATH`	Specifies the Linux path where the log file is written that contains the results of the rebuild or verify action. **Default:** `/var/opt/novell/log/nss/rav/`
`-v, --version`	Displays version information and exits.

ROPTION

ROPTIONs can be used only for the rebuild action.

Option	Description
`-i, --iv-prune`	Prunes an internal volume.
`-l, --loss-file-limit=LIMIT`	Specifies the maximum number of files per volume to quietly prune. **Default:** 100
`-p, --purge-deleted-files`	Purges deleted files.

Option	Description
`-r, --rezid=ZID`	Specifies the threshold to cause a reZID of a volume. **IMPORTANT:** For NSS, a rebuild automatically causes a reZID of a volume if the rebuild finds a ZID over the default value. However, if the `nextAllocatableZid` for a NSS volume is greater than `0xffffffff`, you cannot reZID a volume. This checks all blocks in the system. Rebuilding can take several minutes to several hours, depending on the number of objects in the pool. For all systems, reZID adds a third pass to the rebuild, which increases the time to rebuild a volume by about 50%. For more information about reZID, see Section 17.3, “ReZIDing Volumes in an NSS Pool,” on page 239. **Default:** 0xeffffffff
`-u, --unknown-loss-prune`	Prunes if losses unknown.

VOPTION

VOPTIONs can be used only for the verify action.

Option	Description
`-q, --quick`	Skips cross-tree validations.

B.7.4 Files

/opt/novell/nss/sbin/ravsui

The Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility file.

/var/opt/novell/log/nss/rav/

The default location of the log file for the RAVSUI utility’s rebuild or verify actions. The path is the directory where the file is stored and does not include the filename itself. You can specify a different path for the log file by using the -P=PATH option.

B.7.5 Note

Before you run the RAVSUI utility to perform a pool verify or pool rebuild, you must put the pool into maintenance mode.

Log in as the `root` user, then open a terminal console.

At a terminal prompt, enter

```
nsscon
```

In nsscon, enter

```
nss /PoolMaintenance=poolname
```

Replace *poolname* with the name of the pool you plan to rebuild or verify, such as POOL1.

If you do not place the pool in maintenance mode before starting the utility, you receive NSS Error 21726:

```
NSS error: PoolVerify results
   Status: 21726
     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED
   Source: nXML.cpp[1289]
```

B.7.6 Example

Log in as the `root` user, then open a terminal console.

At a terminal prompt, enter

```
nsscon
```

At the `nsscon` prompt, put the pool that you want to verify (such as POOL1) in maintenance mode by entering

```
nss /PoolMaintenance=POOL1
```

At the terminal prompt, start the RAVSUI utility to verify the pool by entering

```
ravsui -q verify POOL1
```

This command checks the integrity of the data in POOL1 in the current tree. It skips cross-tree validations.

B.8 ravview

The Rebuild and Verify View (RAVVIEW) utility displays specified rebuild or verify log files in human-readable format. The log files are generated by the Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility.

You must log in as the `root` user to run this utility. If the specified pool is active when you run the utility, the ZIDs of files that appear in the log are converted to their `/pathname/filename` format so that they are more easily understood by the reader.

- Section B.8.1, “Syntax,” on page 500
- Section B.8.2, “Arguments,” on page 500
- Section B.8.3, “Options,” on page 500
- Section B.8.4, “Files,” on page 501
- Section B.8.5, “Example,” on page 502

B.8.1 Syntax

```
/opt/novell/nss/sbin/ravview
ravview [OPTION]... rtf filename
ravview [OPTION]... [NOPTION]... rtfn poolname
ravview [OPTION]... [VOPTION]... vbf filename
ravview [OPTION]... [NOPTION]... [VOPTION]... vbfn poolname
```

Poolnames and filenames are case sensitive.

B.8.2 Arguments

The first mandatory argument specifies the type of log file you want to view. This can be rtf, rtfn, vbf, or vbfn. The second argument specifies information about the log you want to view.

IMPORTANT: In the raw log files, files that were acted upon are identified by their ZIDs, not the path and filename. If the pool that was rebuilt or verified is active when you view its log, the utility converts each ZID to display the path and filename instead.

First Argument	Description	Second Argument
rtf	Specifies that you want to view a rebuild results. You must specify the filename of the log you want to view. The utility displays any messages that occurred during the rebuild.	*filename*
rtfn	Specifies that you want to view the newest rebuild results in a specified path for a specified poolname. Optionally, specify the path to the logs by using the -P=PATH option. The utility displays any messages that occurred during the rebuild.	*poolname*
vbf	Specifies that you want to view a verify results. You must specify the filename of the log you want to view. The utility converts the binary file into a human-readable format.	*filename*
vbfn	Specifies that you want to view the newest verify results in a specified path for a specified poolname. Optionally, specify the path to the logs by using the -P option. The utility converts the binary file into a human-readable format.	*poolname*

Replace *filename* with the path and name of the log file for the rebuild or verify process that you want to view.

Replace *poolname* with the name of the NSS pool that was rebuilt or verified.

B.8.3 Options

This section describes the OPTION, VOPTION, and NOPTION options available for the RAVVIEW utility. Mandatory arguments for long options are mandatory for short options too.

OPTION

General options can be used for viewing rebuild or verify logs. Use them in combination with any of the rtf, rtfn, vbf, or vbfn arguments.

Option	Description
`-h, --help`	Displays help information and exits.
`-V, --verbose=LEVEL`	Controls the amount of output.
`-v, --version`	Displays version information and exits.

VOPTION

VOPTIONs are available only for viewing the verify results. Use them in combination with the vbf or vbfn arguments.

Option	Description
`-a, --actions`	Displays action information.
`-H, --histograms`	Displays histograms.
`-o, --object-details`	Displays object details.

NOPTION

NOPTIONS are available for viewing the newest log for a specified pool. Use this option in combination with the rtfn and vbfn arguments.

Option	Description
`-P, --path=PATH`	Specifies the path to RAV log files. **Default:** `/var/opt/novell/log/nss/rav/`

B.8.4 Files

/opt/novell/nss/sbin/ravview

The Rebuild and Verify View utility file.

/var/opt/novell/log/nss/rav/

The default location of the log file for the Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility's rebuild or verify actions. The path is the directory where the file is stored and does not include the filename itself.

You can specify a different path for the log file by using the `-p=path` or `-P` option. This should be the same path that you used when you ran the RAVSUI utility.

B.8.5 Example

Log in as the `root` user, then open a terminal console.

To view the results of the last rebuild of the pool named POOL, enter the following command at the terminal prompt:

`ravview rtfn --path=/test/path/novell/nss/rav_logs/ POOL`

`ravview rtfn -P /test/path/novell/nss/rav_logs/ POOL`

You can specify a path for the log file by using the -`path=`*PATH* or `-P` option. This should be the same path that you specified when you used the ravsui utility. If you do not specify any path then, the default path searched is `/var/opt/novell/log/nss/rav/`.

To view a rebuild results, enter the following command at the terminal prompt:

`ravview rtf /var/opt/novell/log/nss/rav/POOL_rebuild_4ff6bbfd_log.xml`

Note: Specify the full path to the location of your log file.

If you want to view older rebuild results for a pool named DATAPOOL, enter the following command at the terminal prompt:

`cd /var/opt/novell/log/nss/rav`

and then do `ls -larth DATAPOOL_rebuild_*_log.xml`

The command lists all the DATAPOOL rebuild results that are present on the server (in the current directory, which is the default location for rebuild logs in this case).

```
-rw-r--r-- 1 root root 1.8K May 24 14:58 DATAPOOL_rebuild_4fbea0bd_log.xml
-rw-r--r-- 1 root root 1.9K May 30 10:52 DATAPOOL_rebuild_4fc65010_log.xml
```

To view the May 30 rebuild results, enter the following command:

`cd /var/opt/novell/log/nss/rav`

`ravview rtf DATAPOOL_rebuild_4fc65010_log.xml`

To view the results of the last verify operation performed on a pool named "TEST", enter the following command at the terminal prompt:

`ravview vbfn TEST`

To view a specific verify results, enter the following command at the terminal prompt:

`ravview vbf /var/opt/novell/log/nss/rav/TEST_verify_4ffd76a8_report.vbf`

Note: Specify the full pathname of the file where your log file is located.

If you want to view older verify results for a pool named TEST, enter the following command at the terminal prompt:

`cd var/opt/novell/log/nss/rav`

`ls -larth TEST_verify_*.vbf`

The command lists all the TEST verify results that are present on the server (in the current directory, which is the default location for rebuild logs in this case).

```
-rw-r--r-- 1 root root 38K Oct  7  2009 TEST_verify_4acd3641_report.vbf

-rw-r--r-- 1 root root 38K Jan 15  2010 TEST_verify_4b50f319_report.vbf

-rw-r--r-- 1 root root 38K Feb 17 11:52 TEST_verify_4f3ea059_report.vbf
```

To view the October 7, 2009 verify results, enter the following command:

```
cd /var/opt/novell/log/nss/rav

ravview vbf TEST_verify_4acd3641_report.vbf
```

Clustered Environment

In a clustered deployment using OES Cluster Services (NCS), verify and rebuild results for a pool can exist on any of the nodes in a cluster (since pools can be migrated between nodes), or even on a node that is no longer a part of the cluster, but was hosting the pool at the time the verify/rebuild operation was performed. It may be useful to create a common volume/directory, mounted through NFS or other access protocol on all nodes in the cluster to store the rebuild and verify results. For example, you can have an auto-mounted path `/my/shared/rav/logs/` on all the nodes in a cluster.

To verify a pool named MYPOOL on node 1, enter

```
ravsui -P /my/shared/rav/logs/ verify MYPOOL
```

If the pool is then migrated to the node2 in the cluster. To view the logs on node 2, enter

```
ravview -P /my/shared/rav/logs/ vbfn MYPOOL
```

Note: This will work on node 2, if the same log directory is mounted on this node.

To view a specific verify or rebuild file, enter:

```
ravview vbf /my/shared/rav/logs/MYPOOL_verify_4ffd74b8_report.vbf
```

B.9 refreshids

Use this command to force a reset of the NSS ID caches on your OES 2015 server.

B.9.1 Syntax

Issue the command as the `root` user in a terminal console on the OES 2015 server where the NSS volume exists.

```
refreshids

refreshids --help
```

B.10 rights

The Trustee Rights Utility (`rights`) utility for Linux allows you to specify file system trustee rights for directories and files on NSS volumes. The trustee information is saved in the file and directory metadata on the NSS volume so that the volume works seamlessly if used cross-platform on an OES to NetWare server. The namespace is used only for NSS path types.

- Section B.10.1, “Syntax,” on page 504
- Section B.10.2, “Options,” on page 504
- Section B.10.3, “Example,” on page 509
- Section B.10.4, “See Also,” on page 510

B.10.1 Syntax

```
rights [OPTIONS]
rights [TOPTIONS] trustee USERNAME
rights [DOPTIONS] delete USERNAME
rights [IOPTIONS] irf
rights [EROPTIONS] effective USERNAME
rights [FOPTIONS] inherited USERNAME
rights [SOPTIONS] show
```

B.10.2 Options

ACTIONS

The first argument indicates the action to be taken.

Option	Description
`trustee`	Adds or modifies a trustee on a file or directory.
`delete`	Removes a trustee from a file or directory.
`irf`	Sets the inherited rights filter on a directory.
`effective`	Displays a user’s effective rights.
`inherited`	Display the inheritance for a user to a file.
`show`	Displays the trustees and inherited rights filter.

OPTIONS

Option	Description
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the help screen.

TOPTIONS

Option	Description
`-r, --rights=MASK`	Specifies the rights to be given to this trustee. For more information, see "MASK" on page 509. If the No Rights (n) option is assigned, the trustee is removed. If rights are not specified, the default assignment is Read and File Scan rights.
`-f, --file=`*`filename`*	Specifies the name of file or directory to assign trustees to. *Filename* is the path for the file or directory. For example: `-f /users/`*`username/userfile.sxi`* `--file=/designs/topsecret` If a file or directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to assign trustees to DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Beginning with OES 2018 SP3, the `-d` option is set by default. Any operation performed on the DST primary volume is also applied to the shadow volume.
`-p, --no-dst`	Specify this option to assign trustees on the specified volume.
`-S, --softlink`	Do not follow link option.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.
`-a, --activedirectory`	Specifies the Active Directory user name and group. If you have used Windows Server Manager to add users to AD, and if those user names contain any of the following special characters: / \ [ ] : ; | = , + * ? < > @ and ", they are replaced with an underscore (_). Ensure to specify the correct AD user names. The AD user name format is NETBIOSNameOfDomain\\username.

DOPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of file or directory to delete trustees from. *Filename* is the path for the file or directory. If a file or directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to delete trustees from the DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Ensure that the filename specified with this option is a DST or CIS primary volume.
`-p, --no-dst`	Specify this option to delete trustees from a volume.
`-S, --softlink`	Do not follow link option.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.
`-a, --activedirectory`	Specifies the Active Directory user name and group. If you have used Windows Server Manager to add users to AD, and if those user names contain any of the following special characters: / \ [ ] : ; | = , + * ? < > @ and ", they are replaced with an underscore (_). Ensure to specify the correct AD user names. The AD user name format is NETBIOSNameOfDomain\\username.

IOPTIONS

Option	Description
`-r, --rights=MASK`	Specifies the rights to be passed through the filter. For more information, see "MASK" on page 509. If rights are not specified, the default assignment is All Rights.
`-f, --file=`*`filename`*	Specifies the name of the directory where the filter is to be applied. *Filename* is the path for the directory. If a directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to apply filter on the DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Ensure that the filename specified with this option is a DST or CIS primary volume.
`-p, --no-dst`	Specify this option to apply filter on a volume.
`-S, --softlink`	Do not follow link option.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.

EROPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of file or directory where effective rights are to be calculated. *Filename* is the path for the file or directory. If a file or directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to calculate the effective rights of the DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Ensure that the filename specified with this option is a DST or CIS primary volume.
`-p, --no-dst`	Specify this option to calculate the effective rights on a volume.
`-S, --softlink`	Do not follow link option.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.
`-a, --activedirectory`	Specifies the Active Directory user name and group. If you have used Windows Server Manager to add users to AD, and if those user names contain any of the following special characters: / \ [ ] : ; | = , + * ? < > @ and ", they are replaced with an underscore (_). Ensure to specify the correct AD user names. The AD user name format is NETBIOSNameOfDomain\\username.

FOPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of file or directory where effective rights are to be calculated. *Filename* is the path for the file or directory. If a file or directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to display a list of trustees and inherited rights on the DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Ensure that the filename specified with this option is a DST or CIS primary volume.
`-p, --no-dst`	Specify this option to display a list of trustees and inherited rights of a volume.
`-S, --softlink`	Do not follow link option.

Option	Description
`-a, --activedirectory`	Specifies the Active Directory user name and group. If you have used Windows Server Manager to add users to AD, and if those user names contain any of the following special characters: / \ [ ] : ; | = , + * ? < > @ and ", they are replaced with an underscore (_). Ensure to specify the correct AD user names. The AD user name format is NETBIOSNameOfDomain\\username.

SOPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of the file or directory to display a list of trustees for that file or directory. If a file or directory is not specified, the current directory is used.
`-d, --dst-cis`	Specify this option to display the trustees of the DST or CIS primary volume and shadow volume. By default, all operations are performed on both primary and shadow volume. If you prefer to perform operations only on the primary volume, then use `-p` option. **NOTE:** Ensure that the filename specified with this option is a DST or CIS primary volume.
`-p, --no-dst`	Specify this option to display the trustees of a volume.
`-S, --softlink`	Do not follow link option.
`-n, --namespace`	Sets the lookup namespace as DOS, UNIX, LONG or MACINTOSH.
`-u, --unresolvedtrustees`	Specify this option to display the unresolved trustees.

USERNAME

The USERNAME is the fully distinguished name of the eDirectory or Active Directory (AD) object, including the tree name. Use the *`username.context.treename`* format, such as

joe.engineer.acme_tree

If you use special characters in a username, you must escape those special characters in the command line.

For example, the $ (dollar sign) is a special character reserved to the shell and must be escaped. For the bash shell, the command could be written in one of two ways on the command line:

```
rights -f /media/nss/DATA/stuff -r none \$j\$o\$e.engineer.acme_tree
```

```
rights -f /media/nss/DATA/stuff -r none '$j$o$e.engineer.acme_tree'
```

If you are using another shell, the special characters might need a different escape technique. In this case, please refer to the shell documentation for this information.

MASK

The mask is a string of characters, with each character representing certain rights. The following table lists the rights, the letter to use for each right, and what the right is used for. By default, if you do not specify the rights to assign, the specified user gets the Read and File Scan rights (rf) to the specified file or directory.

Right	Letter	Description
Supervisor	s	Has all rights to the file or directory. Also can grant or revoke the Access Control right.
Read	r	Grants the right to open and read files in the directory.
Write	w	Grants the right to open and write to files in the directory.
Create	c	Grants the right to create files and subdirectories. The user can also salvage (undelete) deleted files.
Erase	e	Grants the right to erase files and directories. The user can also purge deleted files.
Modify	m	Modifies the metadata of the file or directory. For example, rename files and directories, or change file attributes.
File Scan	f	Grants the right to display and search on file and directory names in the file system structure.
Access Control	a	Grants the right to add and remove trustees, and change trustee rights to files and directories. This right does not allow the trustee to add or remove the Supervisor right for any user. Also, it does not allow to remove the trustee with the Supervisor right.
No Rights	none	Revokes all rights.
All Rights	all	Grants all rights (srwcemfa)

B.10.3 Example

```
rights -f /designs/topsecret -r rwfc trustee joe.engineer.acme_tree
```

This command assigns Read, Write, File Scan, and Create rights to the `/designs/topsecret` directory for user `joe` in the engineer context of the `acme_tree` eDirectory tree.

For Active Directory users, use the netbios name of the AD domain followed by the user name. For example, NETBIOSNameOfDomain\\user.

```
rights --file=/designs/topsecret/joe.txt trustee
jsmith.engineering.acme_tree
```

This command assigns Read and File Scan rights (the default rights setting) to the `/designs/topsecret/joe.txt` file for user `joe` in the engineer context of the `acme_tree` eDirectory tree.

```
rights -d -f /designs/topsecret show
```

This command displays the trustees and inherited rights filter of the DST primary volume and shadow volume. In this example, `/designs/topsecret` represents the DST primary volume.

```
rights -d -f /dept/hr show
```

This command displays the trustees and inherited rights filter of the CIS primary volume and shadow volume. In this example, `/dept/hr` represents the CIS primary volume.

B.10.4 See Also

For information about setting file system directory and file attributes, see "attrib" on page 483.

B.11 volumes (NCP Console Utility)

Use this utility at the ncpcon (NCP Console utility) prompt (Linux) to list mounted volumes or information about a specified volume. For information about the NSS `volumes` command, see Section A.37.1, "Volumes Command," on page 478.

- Section B.11.1, "Syntax," on page 510
- Section B.11.2, "Using volumes," on page 510
- Section B.11.3, "Using volume name," on page 511

B.11.1 Syntax

Command	Description
`volume` *name* `ncpcon volume` *name*	Displays details about the specified volume. Linux is case-senstive, so make sure that you enter the volume name in all caps, such as `volume VOL1`
`volumes` `ncpcon volumes`	Displays general information about all mounted volumes.

B.11.2 Using volumes

When you execute `volumes` at the ncpcon prompt, a list of the mounted volumes is displayed.

For example, a simple list of volumes is displayed:

```
Mounted Volumes
        SYS
        USERS
        TEST
        _ADMIN
        VOL1
5 volumes mounted.
```

B.11.3 Using volume name

When you execute `volume` *name*, the screen displays detailed information about the specific volume.

The following is an example of the output on Linux in response to entering `volume` USERS at the ncpcon prompt, or entering `ncpcon volume` USERS at the terminal console prompt:

```
            Volume: USERS
            Status: online mounted NSS "user quotas" "directory quotas"
salvageable
       Mount point: /media/nss/USERS
Shadow Mount point: (null)
          Capacity: 8.83 GB
                ID: 4
              GUID: 9a894a30-70a3-01dd-80-00-32b3b21ae612
         Pool Name: POOL1
```

B.12 nsssettings

This utility is used to print the active volume and pool level settings. Execute the `nsssettings` command in an OES server to print volume and pool level settings.

B.13 nssquota

Use this utility to set, get, or clear the userspace quota, directory quota, and volume quota on NSS volumes and files. The namespace is used only for NSS path types.

- Section B.13.1, “Syntax,” on page 511
- Section B.13.2, “Options,” on page 512
- Section B.13.3, “Examples,” on page 513

B.13.1 Syntax

Command	Description
`nssquota <USERQUOTAOPTIONS>`	It is used to set, get, or clear user space quota on NSS volumes.
`nssquota <DIRECTORYQUOTAOPTIONS>`	It is used to set, get, or clear directory quota on NSS sub-directory files.
`nssquota <VOLUMEQUOTAOPTIONS>`	It is used to set, get, or clear volume quota on NSS volumes.

B.13.2 Options

Usage Options

Option	Description
`-h, --help`	Displays the help information.
`-v, --version`	Displays the program version information.

USERQUOTAOPTIONS

Option	Description
`-U, --userquota`	Sets the userquota options (set, get, or clear).
`-s, --size=quota (in KB/ MB/GB)`	Storage space allowed for the specified user. The default unit is MB.
`-V, --volumename=volumename`	Name of the volume for which quota has to be set.
`-u, --username`	Specify the user name.
`-g, --getquotas`	Gets the user quota.
`-c, --clear`	Removes the quota restriction.
`-a, --activedirectory`	Specifies the active directory user name. If you have used Windows Server Manager to add users to AD, and if those user names contain any of the following special characters: / \ [ ] : ; | = , + * ? < > @ and ", they are replaced with an underscore (_). Ensure to specify the correct AD user names. The AD user name format is NETBIOSNameOfDomain\\username.
`-p`	Option to perform operations on the DST primary and shadow volume. This is set by default. **NOTE:** Beginning with OES 2018 SP3, the -p option is set by default. Any operation performed on the DST primary volume is also applied to the shadow volume.
`-k, --no-dst`	Perform operations on the specified volume.

DIRECTORYQUOTAOPTIONS

Option	Description
`-D, --directoryquota`	Sets the directory quota options (set, get, or clear).
`-s, --size=quota (in Multiples of 4KB/MB/GB)`	Size of the quota. The default unit is KB.
`-d, --directoryname`	Sub-directory name.

Option	Description
`-n, --namespace`	Indicates the path lookup namespace(DOS, UNIX, LONG, MACINTOSH).
`-g, --getquotas`	Gets the directory quota.
`-c, --clear`	Removes the quota restriction.
`-p, --dst`	Option to perform operations on the DST primary and shadow volume. This is set by default. **NOTE:** Beginning with OES 2018 SP3, the -p option is set by default. Any operation performed on the DST primary volume is also applied to the shadow volume.
`-k, --no-dst`	Perform operations on the specified volume.

VOLUMEQUOTAOPTIONS

Option	Description
`-V, --volumename`	Name of the volume for which quota has to be set.
`-s, --size=quota (in Multiples of KB/MB/GB/TB)`	Size of the quota. The default unit is GB.
`-Q, --volumequota`	Sets, gets or clears the volume quota options.
`-g, --getquota`	Gets the volume quota.
`-c, --clear`	Removes the quota restriction

B.13.3 Examples

```
nssquota -U -V VOL -u wwrun.novell -s 30GB
```

This example is for user quota.

```
nssquota -D -d /media/nss/VOL/test -s 4GB -p
```

This example is for directory quota.

```
nssquota -Q -V VOL -s 100GB
```

This example is for the volume quota.

For Active Directory user quota options, use the NetBIOS name of the AD domain followed by the user name. For example, NETBIOSNameOfDomain\\user.

```
nssquota -a -g -U -V VOL
nssquota -a -g -U -V VOL -u NETBIOSNameOfDomain\\joe
nssquota -a -U -V VOL -u NETBIOSNameOfDomain\\joe -s 100MB
nssquota -a -c -U -V VOL -u NETBIOSNameOfDomain\\joe
```

These examples are for active directory based user quota options.

B.14 nssraid

Use this utility to view the status of the NSS RAID 1 (mirror) devices, segment information, to restart and stop the remirror process of the NSS RAID 1 devices, and to delete a single disk mirror RAID 1 device.

- Section B.14.1, “Syntax,” on page 514
- Section B.14.2, “Options,” on page 514
- Section B.14.3, “Example,” on page 514

B.14.1 Syntax

nssraid status | remirror | abort / *delete <RAID_name>*

B.14.2 Options

Usage Options

Option	Description
`nssraid status`	Display the status of all the NSS RAID 1 devices.
`nssraid status <RAID_name>`	Display segment information of the NSS RAID 1 device.
`nssraid remirror <RAID_name>`	Restart remirror process on NSS RAID 1 device.
`nssraid abort <RAID_name>`	Stop remirror process on NSS RAID 1 device.
`nssraid delete <RAID_name>`	Deletes a single disk mirror RAID 1 device.

B.14.3 Example

To stop remirroring mirror the NSS RAID 1 device, MYRAID1, enter

```
nssraid abort MYRAID1
```

B.15 ncsinit

Use this utility to initialize a device and to set the device to a shared state.

- Section B.15.1, “Syntax,” on page 515
- Section B.15.2, “Options,” on page 515
- Section B.15.3, “Example,” on page 515

B.15.1 Syntax

ncsinit [-f -z -u] <*full_disk_path*>

B.15.2 Options

Usage Options

Option	Description
`-f`	Forces initialization. Initializes the device even if the device is already initialized.
`-z`	Adds zero to the end of the specified device for upto a maximum of 32 sectors.
`-u`	Undo the initialization if the device is already initialized. Need to run nlvm to re-scan the device. **NOTE:** -u and -z options can not be used together.

B.15.3 Example

Example for initializing and sharing the disk,

`ncsinit /dev/sda`, where sda is the device which is getting initialized and shared.

Example for reinitializing a disk that is already initialized,

`ncsinit -f /dev/sda`, where sda is the device which is getting reinitialized and shared.

B.16 nsschown

Use this utility to change and list the owners of the NSS files and directories, to identify the files and directories that have obsolete owners, and to list or change the files owned by a owners in a directory or volume level.

B.16.1 Syntax

```
nsschown -l <path> -r <yes/no> {-g <oldGUID> | -S <oldSID> | -u
<olduserFDN> | -U <oldADUserName> | -a | -i [-b <bind_FDN>] [-p
<password>]} [-n <newuserFDN> | -N <newADUserName>][-e] [-d] [-c] -v
```

B.16.2 Options

Usage Options

-l *<path>*

To list or replace the ownership of a specified directory.

-r *<yes/no>*

To list or replace the ownership of the specified directory, the files and sub-directories. The default is yes and that will list or replace the entire directory. If set to no, it will list or replace only the specified directory or file.

-g *<oldGUID>*

To list or replace all the files and directories with a specified owner's GUID.

-S *<oldSID>*

To list or replace all files and folders with a specified owner's SID.

-u *<Old_User_FDN>*

To list or replace all the files and directories with a specified owner. The owner can be a fully qualified FDN or root.

-U *<oldADUserName>*

To list or replace all files and folders with specified active directory owner. It can be DN or root. The AD user name format is NETBIOSNameOfDomain\\username.

-a

To list or replace all the files and directories irrespective of the current owner.

-i

To list or replace all the files and directories having invalid owner IDs.

-b *<Bind_FDN>*

Provide a user FDN that has browse rights at root tree level. This user will be used to login to the eDirectory tree for doing a tree-wide lookup for owner GUIDs. By default, [Public] has browse tree right. User FDN and password must be provided if [Public] does not have browse tree rights.

-p *<password>*

Provide the appropriate user FDN password for the eDirectory login. Failing which you will be prompted to provide a password.

-n *<new_user_FDN>*

To replace the ownership of all the files or directories found with the new user. It can be FDN or root.

-N *<newADUserName>*

To change the ownership of all the files and folders with the new active directory user. It can be DN or root. The AD user name format is NETBIOSNameOfDomain\\username.

-e

To list or replace the owner of all extended attributes and data streams.

-d

To list or replace ownership of all the files and directories on the DST primary and shadow volume.

NOTE: Beginning with OES 2018 SP3, the -d option is set by default. Any operation performed on the DST primary volume is also applied to the shadow volume.

-c

To list or replace ownership of all files and directories on the specified volume.

-v

To display the program version information.

Examples

- To list the owners of all files and directories under the directory named “dir”:

  ```
  nsschown -l CVOL:dir -a
  ```

- To list the owners of all the files and directories under the directory named “dir” along with all the extended attributes and data streams:

  ```
  nsschown -l CVOL:dir -a -e
  ```

- To replace owners of all files and directories under “CVOL:dir” that have owner GUID as “1234567a-7834-0000-00-12-123456781234” with the user “.newuser.context.tree.”. This includes all files and sub-directories under the “dir” directory.

  ```
  nsschown -l CVOL:dir -g 1234567a-7834-0000-00-12-123456781234 -n
  .newuser.context.tree.
  ```

- To replace owners of all files and directories under “CVOL:dir” that have owner name as “.olduser.context.tree.” with the user “.newuser.context.tree.”. This includes all files and sub-directories along with all the extended attributes and data streams under the “dir” directory.

  ```
  nsschown -l CVOL:dir -u .olduser.context.tree. -n
  .newuser.context.tree. -e
  ```

- To replace the ownership of “CVOL:dir” alone with the new user “.newuser.context.tree.”.

  ```
  nsschown -l CVOL:dir -r no -a -n .newuser.context.tree.
  ```

- To list all files and directories under “CVOL:dir” that have invalid owners, and the eDirectory login credentials used to valid the owners are “.loginuser.context.tree.” and “password123”.

  ```
  nsschown -l CVOL:dir -i -b .loginuser.context.tree. -p password123
  ```

- To replace all the owners of all files and directories under “CVOL:dir” that have owner’s SID as S-1-2-21-3975909043-813829848-2338043596-1107 with the eDirectory user .newuser.context.tree.

  ```
  nsschown -l CVOL:dir -S S-1-2-21-3975909043-813829848-2338043596-1107 -
  n .newuser.context.tree.
  ```

- To replace all the owners of all files and directories under “CVOL:dir” that have owner’s SID as S-1-2-21-3975909043-813829848-2338043596-1107 with the Active Directory user NETBIOSNameOfDomain\\joe.

  ```
  nsschown -l CVOL:dir -S S-1-2-21-3975909043-813829848-2338043596-1107 -N NETBIOSNameOfDomain\\joe
  ```

- To replace all the owners of all files and directories under “CVOL:dir” that have AD owners NETBIOSNameOfDomain\\fromUser with the new AD owner NETBIOSNameOfDomain\\toUser.

  ```
  nsschown -l CVOL:dir -U NETBIOSNameOfDomain\\fromUser -N NETBIOSNameOfDomain\\toUser
  ```

- To replace all the owners of all files and directories under “CVOL:dir” that have AD owners NETBIOSNameOfDomain\\fromUser with the new eDirectory owner .newuser.context.tree.

  ```
  nsschown -l CVOL:dir -U NETBIOSNameOfDomain\\fromUser -n .newuser.context.tree.
  ```

B.17 map-users

Use this utility to generate a user map after specifying the necessary match type, context and so on.

For more information on this utility, see map-users in the OES 2018 SP3: NSS AD Administration Guide.

B.18 user-rights-map

Use this utility to map the rights of the mapped eDirectory and Active Directory users, groups, and containers. The mapped rights information is stored in a file and assigned an ID. Using this id, you can synchronize the rights of the users.

For more information on this utility, see user-rights-map in the OES 2018 SP3: NSS AD Administration Guide.

B.19 sputil

Use this utility to perform the purge operation.

- Section B.19.1, “Syntax,” on page 518
- Section B.19.2, “Options,” on page 519
- Section B.19.3, “Examples,” on page 520

B.19.1 Syntax

```
/opt/novell/nss/sbin/sputil
```

```
sputil <AOPTION> <PAOPTION> [POPTION] [OPTION]
```

B.19.2 Options

This section describes the OPTION, AOPTION, PAOPTION, and POPTION options available in the SPUTIL utility.

NOTE: The command action is irreversible.

General Options (OPTION)

Option	Description
`--force`	Performs the purge operation by suppressing all user confirmations.
`--dry-run`	Use this option to display the total number of files that could be purged from volumes and the total space that could be reclaimed in a pool after purging.
`--list-files`	Use this option to view all the deleted files and the time of deletion. This option should be used only with the --dry-run option.
`-h, --help`	Displays the help information.

Action Options (AOPTION)

Option	Description
`--purge`	Invokes the purge operation.

Purge Action Options (PAOPTION)

Option	Description
`--get`	Lists the volume configurations.
`--set`	Sets the volume configurations.
`--exec`	Executes the operations based on the configurations that have been preset. **NOTE:** To obtain the statistics information, run `--dry-run` option
`--clear`	Removes the file extension that is configured during the set operation.

Purge Options (POPTION)

Option	Description
`-e, --ext`	Specify the file extension. It is mandatory to specify a meaningful name for the extension. If you specify “*”, “.” and so on as extension, the behavior of the operation is undefined. For example: `--ext doc --ext txt`

`-a, --age`	Specify the age in seconds(s), minutes(m), hours(h), or days(d). Any file that is older than the specified age is purged. The default value is in days. If the value is 0, no purge action is performed. The maximum age is 49710 days. For example:
	`-a 30s`
	`-a 30m`
	`-a 20h`
	`-a 300d`
	`-a 0`

`-p, --poolname`	Specify the pool name.
`-v, --volname`	Specify the volume name.

B.19.3 Examples

To list all the pools and volume configurations:

```
sputil --purge --get
```

To set the configuration for purge operation with the age as “250d”, file extension as “doc”, and volume name as “VOL1”:

```
sputil --purge --set --age 250d --ext doc --volname VOL1
```

NOTE: In the preceding example, the purge operation is performed if any one of the following conditions are met:

- Files that are older than 250 days.
- Files with “doc” extension.

To clear the configuration with file extensions as “doc” and “txt”, and volume name as “VOL1” for purge operation:

```
sputil --purge --clear -e doc -e txt -v VOL1
```

To execute the purge operation based on the configurations that have been preset:

```
sputil --purge --exec
```

To execute the purge operation for the volume “VOL1”:

```
sputil --purge --exec -v VOL1
```

To display the statistics information:

```
sputil --purge --exec --dry-run --list-files
```

This command displays only the statistics information. It does not perform the `--exec` operation.

NOTE:

- Pool name and volume name cannot be specified together in a single command.
- If you need to perform purge operation periodically, use crontab command.

C Using Linux Commands to Manage NSS Devices

The OES Storage Services (NSS) file system can exist on devices managed by any volume manager.

WARNING: The NSS configurations described in this section are untested and are not supported by Micro Focus Support. Also, some key features, such as clustering with OES Cluster Services, are not available.

Beginning with OES 11, the Enterprise Volume Management System (EVMS) was obsoleted by the new OES Linux Volume Manager (NLVM). NLVM addressed EVMS deficiencies that were reasons that you might have used Linux commands to create pools and volumes on OES 2 SP3 and earlier. For example:

- NLVM allows you to easily create pools on devices that contain Linux partitions and volumes.
- NLVM provides a command line interface that supports scripting to create and manage pools and volumes.
- NLVM creates pool objects in Device Mapper (DM) directly off the device, which improves NSS file system performance as compared the way the storage objects were created in DM by EVMS.

On OES 11 and later, the NSS management code does not support the pools that you create with the Linux mkfs command. You can use NSS commands to view and activate/deactivate the pool, but you cannot use NSS management tools (NSSMU, NLVM commands, and the Storage plug-in to iManager) to perform NSS management tasks such as expand, delete, and move. You must use mkfs to create volumes on the pool, but once created, the volumes can be detected and managed with NSS commands and management tools.

For these reasons, we strongly discourage you from using the Linux mkfs command to create NSS pools and volumes on OES 11 and later.

These instructions are only for those who can accept the risks involved with using an unsupported method. Everyone else should follow the instructions in Chapter 4, “Installing and Configuring OES Storage Services,” on page 43.

This section describes the following:

- Section C.1, “Creating and Mounting NSS Pools and Volumes by Using Linux Commands,” on page 524
- Section C.2, “Configuring Default Mount Settings for NSS Pools and Volumes,” on page 527
- Section C.3, “Expanding NSS Pools,” on page 529
- Section C.4, “Deleting NSS Pools,” on page 529
- Section C.5, “Copying Data from a Linux-Managed Pool to an NSS-Managed Pool,” on page 529

C.1 Creating and Mounting NSS Pools and Volumes by Using Linux Commands

Use the following procedure to create and mount an NSS pool and volume.

- Section C.1.1, “Using the Linux mkfs Command to Create NSS Pools,” on page 524
- Section C.1.2, “Creating a Partition,” on page 525
- Section C.1.3, “Creating and Mounting an NSS Pool,” on page 525
- Section C.1.4, “Creating and Mounting an NSS Volume,” on page 526

C.1.1 Using the Linux mkfs Command to Create NSS Pools

The Linux `mkfs` command is used to build a file system on Linux. This section describes how to use the Linux `mkfs` command to create an NSS file system pool.

WARNING: Be careful with this command. The `mkfs` command destroys any existing data on the specified device or partition.

Syntax

`mkfs [ -t fs-type ] [ fs-options ] filesys`

Option or Parameter	Description

`-t fs-type`	Specifies the type of file system to be built, such as nsspool or nssvol. For example:
	`-t nsspool`
	`-t nssvol`

`fs-options`	File-system-specific options to be passed to the real file system builder.
	When creating an NSS pool, use this fs-option:
	`-n poolname`
	Replace *poolname* with the actual name of the pool you want to create.
	When creating an NSS volume, use this fs-option:
	`-n volname`
	Replace *volname* with the actual name of the volume you want to create.

`filesys`	When using nsspool as the fs-type, replace *filesys* with the device name (*devname* such as `/dev/hda1` or `/dev/sdb2`). When using nssvol as the fs-type, replace *filesys* with the pool name (*poolname* such as POOL2).

Examples

`mkfs -t nsspool -n poolname devname`

`mkfs -t nssvol -n volname poolname`

C.1.2 Creating a Partition

Use the following procedure to create a `/dev/partition`device, such as `/dev/hda2`or `/dev/sda5`.

1. Log in to the server as the `root` user, or use the `su` command to become `root`.
2. Go to the **YaST > System Partitioner**, then select **Create a Partition**.
3. Select a device with free space available.
4. Create a partition. The name is automatically specified, such as *hda2* or *sda5*.
5. If you do not want to use all of the available free space, specify the amount of space to use.

   Make sure the partition size is sufficient for the NSS pool you want to create later; the partition size determines the pool size.
6. Select **Unformatted**.
7. Do not specify the mount point; leave the **Mount Point** field blank.
8. Click **OK** to create the partition.
9. Continue with Section C.1.3, “Creating and Mounting an NSS Pool,” on page 525.

C.1.3 Creating and Mounting an NSS Pool

1. Log in to the server as the `root` user, or use the `su` command to become `root`.
2. At a system command prompt, enter

   `mkfs -t nsspool -n poolname devname`

   Replace *poolname* with the name you want to use, such as POOL2. Replace *devname* with the device you created in Section C.1.2, “Creating a Partition,” on page 525.

   IMPORTANT: Do not use ampersand (&) and pound (#) characters in pool and volume names; it creates problems in the `/etc/fstab` file. For information about other naming conventions, see “Naming NSS Storage Objects” on page 61.

   For example, enter

   `mkfs -t nsspool -n POOL2 /dev/hda2`

   where POOL2 is the pool name and `/dev/hda2` is the device name.
3. If the location where you want to mount the NSS pool does not already exist, create the mount point. At the server command prompt, enter

   `mkdir /mnt/pooldir`

The /mnt directory is the default location for mounting devices. If you are using a different location, replace /mnt with that path. Replace *pooldir* with the name (path) you want to use, such as POOL2. If you want to make it a hidden directory, begin the directory name with a period, such as .POOL2.

For example, enter

```
mkdir /mnt/.POOL2
```

where /mnt/.POOL2 is the mount point for your pool.

4 Mount the NSS pool. At a system command prompt, enter

```
mount -t nsspool devname mountpoint -o name=poolname
```

For example, enter

```
mount -t nsspool /dev/hda2 /mnt/.POOL2 -o name=POOL2
```

5 Use NSSMU to create a Storage object in eDirectory for the newly created pool.

5a At a terminal prompt, enter

```
nssmu
```

5b From the NSSMU menu, select **Pools**.

5c Select the pool from the **Pools** list, then press **F4** (NDS Update).

6 Continue with Section C.1.4, “Creating and Mounting an NSS Volume,” on page 526.

C.1.4 Creating and Mounting an NSS Volume

1 Log in to the server as the root user, or use the su command to become root.

2 Make sure the pool where you want to create the volume is mounted.

For information, see Section C.1.3, “Creating and Mounting an NSS Pool,” on page 525.

3 Create an NSS volume. At the system console, enter

```
mkfs -t nssvol -n volname poolname
```

Replace *volname* with the name you want to use, such as NSSV1. Replace *poolname* with the NSS pool where the volume will reside, such as POOL2. This is the pool you created in Section C.1.3, “Creating and Mounting an NSS Pool,” on page 525.

IMPORTANT: Do not use ampersand (&) and pound (#) characters in pool and volume names; it creates problems in the /etc/fstab file. For information about other naming conventions, see “Naming NSS Storage Objects” on page 61.

For example, enter

```
mkfs -t nssvol -n NSSV1 POOL2
```

4 If the location where you want to mount the NSS volume does not already exist, create the directory path. At the server command prompt, enter

```
mkdir /media/nss/volname
```

The `/media/nss` path is the default location for NSS volumes. If you are using a different location, replace /media/nss with that path. Replace *volname* with the name of the volume you created in Step 3.

For example, enter

```
mkdir /media/nss/NSSV1
```

5 Mount the NSS volume. At a system command prompt, enter

```
mount -t nssvol VOL volmountpoint -o name=volname
```

For example, enter

```
mount -t nssvol VOL /media/nss/NSSV1 -o name=NSSV1
```

C.2 Configuring Default Mount Settings for NSS Pools and Volumes

Whenever you create NSS pools and volumes from the command line, their mount information is not added by default to the `/etc/fstab` configuration file. After creating the pool and volume, make sure to edit the `/etc/fstab` configuration file to add entries for them.

- Section C.2.1, “Understanding Entries in the /etc/fstab Configuration File,” on page 527
- Section C.2.2, “Adding NSS Pool and Volume Mount Information to /etc/fstab,” on page 528

C.2.1 Understanding Entries in the /etc/fstab Configuration File

The `/etc/fstab` file is a configuration file that contains information about all the devices and partitions on your Linux computer. Each line is an entry that describes where and how to mount one device or one partition. The following table describes the field information needed for NSS pools and volumes.

Table C-1 *Options in the /etc/fstab File*

Column in /etc/fstab	Description	Examples
Device name	The location of the device or partition you want to mount.	`/dev/hda3` `/dev/sdb1`
Mount point	The default location where the device or partition is to be mounted if the mount point is not otherwise specified in a mount command.	`/mnt/.pool2` `/media/nss/NSSV1`
File system type	The file system type of the device or partition.	`nsspool` `nssvol`

Column in /etc/fstab	Description	Examples

Mount options	Lists the comma-delimited mount options for the device or partition. Use a comma without spaces between options.
	
	auto or noauto: Use auto if you want the volume to mount automatically after a system reboot. Use noauto if you want the device to be mounted only when you explicitly issue the mount command. Do not use the auto command for encrypted NSS volumes; they require a password to be entered on the first mount after a system reboot.
	
	rw: Use rw to mount the device as read-write.
	
	name=<poolname | volname>: Specify the *poolname* or *volname* of the partition to be mounted.
	
	noatime: Use noatime for volumes when you want a file's access time (atime) to not be updated for reads.
	
	nodiratime: Use nodiratime for volumes when you want a directory's access time to not be updated for enumerations.
		`noauto,rw,name=POOL2`
		
		`noauto,rw,name=NSSV1`
		
		`name=POOL2,NSSV1,noatime,nodiratime`
		
		`name=NSSV1,noatime,nodiratime`

Dump option number	Designates if the file system should be dumped with the Linux Dump utility. A value of 0 indicates that Dump should ignore this file system. Set this value to 0 for NSS pools and volumes.	`0`
File system check number	Designates if the file system should be checked with the Linux fsck utility. A value of 0 indicates that fsck should ignore this file system. Set this value to 0 for NSS pools and volumes.	`0`

C.2.2 Adding NSS Pool and Volume Mount Information to /etc/fstab

For information about completing the fields for an entry in the `/etc/fstab` file, see Section C.2.1, "Understanding Entries in the /etc/fstab Configuration File," on page 527.

1. Log in as the `root` user, or use the `su` command to become `root`.
2. In a text editor, open the `/etc/fstab` configuration file.

   IMPORTANT: When working in `/etc/fstab`, make sure not to leave any stray characters or spaces in the file. This is a configuration file, and it is highly sensitive to such mistakes.

3. Locate the area in `/etc/fstab` where partitions are defined, then add a line defining the mount information for the NSS pool.

devname mountpoint fstype mountoptions dump# fsck#

For example, suppose you created POOL2 on device /dev/hda2 and mounted it at /mnt/.POOL2. In the /etc/fstab file, the line to add would be

```
/dev/hda2 /mnt/.POOL2 nsspool noauto,rw,name=POOL2 0 0
```

If you want to mount an NSS pool automatically after a system reboots, make sure to use the auto command.

4 Locate the area in /etc/fstab below where you entered pool information, then add a line defining the mount information for the NSS volume.

devname mountpoint fstype mountoptions dump# fsck#

Make sure to place the NSS volume entry after its pool entry to ensure that the pool is mounted before the volumes in it.

For example, suppose you created volume NSSV1 and mounted it at /media/nss/NSSV1. In the /etc/fstab, the line to add would be

```
NSSV1 /media/nss/NSSV1 nssvol noauto,rw,name=NSSV1 0 0
```

If you want to mount a non-encrypted NSS volume automatically after a system reboots, make sure to use the auto command on both the pool it is in and the volume.

5 Save the /etc/fstab file to accept your changes.

C.3 Expanding NSS Pools

After using Linux utilities to move the pool to a larger device and to increase the partition size to the size of the device, use the NSS Update utility to increase the pool size up to the size of the new device. For instructions see, Section B.6, “nssupdate,” on page 495.

C.4 Deleting NSS Pools

To delete a pool that you created with the mkfs command, unmount the pool and volume, then delete the partition that you created in Section C.1.2, “Creating a Partition,” on page 525. You can use fdisk, YaST, or parted to delete the partition. You can also use the `nlvm delete partition <partition_name>` command.

C.5 Copying Data from a Linux-Managed Pool to an NSS-Managed Pool

There is no direct method for converting a Linux-managed pool to be recognized and managed by NSS management tools. You can create an NSS pool with NSS tools, and then copy or use backup/restore to copy the files from the old pool to the new pool.

D List of NSS Features

This section lists the features and capabilities of OES Storage Services on Open Enterprise Server (OES) servers.

Feature Description	NSS for OES 2018 SP2
Management interfaces	iManager
	NSSMU for Linux
	NLVM. For more information, see *OES 2018 SP3: NLVM Reference*.
	Utilities in the terminal console (NSSMU, RIGHTS, NSSCON, ATTRIB, RAVSUI, RAVVIEW, nssquota, ncsinit, `nbackup(1)` (http://www.novell.com/documentation/oes/smsadmin/data/nbackup.1.html))
	NSS commands in the NSS Console (NSSCON)
	OES Remote Manager for Linux (for Dynamic Storage Technology shadow volumes and for managing NCP Server connections to NSS volumes)
	OES NetStorage for Linux
File system trustees, trustee rights, and inherited rights filter to control access to directories and files	Files and Folders plug-in to iManager
	OES NetStorage for Linux (via Web browser only, not WebDAV)
	Client for Open Enterprise Server
	RIGHTS utility for Linux
File system directory and file attributes to control functions available for directories and files	Files and Folders plug-in to iManager OES NetStorage for Linux Client for Open Enterprise Server
Directory quotas management (requires the Directory Quotas attribute for the volume)	Files and Folders plug-in to iManager OES NetStorage for Linux
User space quota management (requires the User Space Quotas attribute for the volume)	Storage plug-in to iManager
Default mount location for NSS pools	`/opt/novell/nss/mnt/.pools/poolname`
Default mount location for NSS volumes	`/media/nss/volumename`
File system type (as recognized and reported by the operating system)	nssvol

Feature Description	NSS for OES 2018 SP2
File access protocols	NCP OES AFP for Linux OES CIFS for Linux Linux NFS (version 3) Linux NFS requires users to be Linux-enabled with Linux User Management. The service must also be enabled.
Interface	64-bit
Character format	Unicode
Maximum device size recognized (physical or logical)	2E64 512-byte sectors
Maximum software RAID device size	8 TB (GPT) for NSS32 Pools 8 EB (GPT) for NSS64 Pools 2 TB (DOS) for NSS32 and NSS64 Pools **NOTE:** The pools are currently limited to 8 TB for NSS32 and 8 EB for NSS64, RAID1 sizes for pool objects are also limited to 8 TB or 8 EB depending on the pool type.
Minimum software RAID segment size	12 MB per segment
Maximum partition size	8 TB for NSS32 and 8 EB for NSS64 pools Valid Range: 12 MB to 8 TB for NSS32 pools, and 12 MB to 8 EB for NSS64 pools **NOTE:** The Maximum segment size corresponds only to GPT partition. If all devices are partitioned using DOS, the size limits to 2TB.
Maximum number of partitions per pool	No practical limit
Maximum pool size	8 TB for NSS32 pools 8 EB for NSS64 pools
Minimum pool size	12 MB
Maximum size of a volume	Up to 8 TB for NSS32, depending on the pool size and available space in the pool. Up to 8 EB for NSS64, depending on the pool size and available space in the pool.
Maximum file size	Up to 8 TB for NSS32, depending on the volume size and available space in the volume. Up to 8 EB for NSS64, depending on the volume size and available space in the volume.

Feature Description	NSS for OES 2018 SP2
Maximum number of files per volume	Up to 8 trillion, regardless of how many name spaces are loaded. **NOTE:** NSS can support this. You are limited by the browser and application ability, of course.
Maximum number of files open concurrently	No practical limit on the number of files open concurrently. If any number is limited, it might be because of the system, file access protocols or any similar configuration. Other factors such as system resources can also influence this number.
Maximum number of volumes per server	No practical limit on the number of NSS data volumes.
Time to mount a volume	Requires only a few seconds, thanks to journaling.
Volume name space	Accommodates all name spaces (DOS, Macintosh, Long, and UNIX). Long is the default name space. The Lookup Name Space attribute allows you to set the default name space used when mounting volumes. Directory names and filenames are case insensitive with the Long name space.
Minimum server memory required to activate a volume	Requires only 4 MB available RAM to activate a single volume of any size and any number of files. Loads a file's metadata into memory only as you access the file.
File access time	Same for each file, regardless of its location on the volume.
Error correction and data recovery time on system failure	Journaling file system logs changes. On system failure, replays the most recent transactions to confirm validity, then repairs errors or rolls back to the original condition, typically in 15 to 60 seconds, unless the volume is corrupted.
Repair of corrupted pools and volume	Ongoing journaling of the file system; if the pool metadata structure is corrupted, use the RAVSUI utility to verify and rebuild the volume.
Time to repair corrupted volume	From a few seconds to several hours, depending on the volume size.
Multiple connection paths to storage media	Use a native Linux multiple path I/O solution.
Software RAID support	RAID 0 (striping) RAID 1 (mirroring) RAID 5 (striping with parity) RAID 0+1 (mirroring RAID 0 devices) RAID 5+1 (mirroring RAID 5 devices)

Feature Description	NSS for OES 2018 SP2
Volume encryption	Yes You must mount encrypted volumes only from NSSMU on the first mount after a system reboot so that you can enter the password. The NSSCON utility does not support entering a password from the command line.
Data shredding	Yes, up to 7 times
File compression	Yes
Data migration	Yes
Directory quotas	Yes
User space quotas (user space restrictions)	Yes
Salvage or purge deleted files, directories, or volumes	Yes
Transaction Tracking System (TTS)	Not supported. If you need content tracking and trustee support, use NCP volumes on Linux reiser, XFS, or ext3 file systems, then set the file system's journaling mode to the Journaling option.
Read ahead blocks	Yes
File save time	Provides the group write options and timers. For information, see Section 28.3, "Configuring or Tuning Group I/O," on page 396.
File-level snapshot (make a temporary snapshot copy of an open file for backup)	No
Modified File List	Yes
Pool snapshot (retain point-in-time version of a pool using block-level copy on write)	Yes The stored-on pool must be on a separate partition. Pool snapshots are not supported for clustered NSS pools on Linux.
Backup systems support	*OES 2018 SP3: Storage Management Services Administration Guide for Linux* For an overview of backup resources on Linux, see Chapter 27, "Managing Backup and Restore for Data and Trustee Information," on page 389.
Distributed File Services for moving and splitting NSS volumes	Yes
OES Archive and Version Services	Yes
Device maintenance support	Activate and deactivate devices by pool.
CD and DVD device recognition	No; use Linux POSIX file system options instead.

Feature Description	NSS for OES 2018 SP2
CD and DVD image files	No; use Linux POSIX file system options instead.
Ability to access DOS partitions on the NetWare server	No; use Native Linux file system options instead.
Operating system version detection	Default process
Cache balancing for NSS cache buffers	Yes; for information, see "Tuning NSS Performance" on page 395.
Tuning I/O write behavior	Set group I/O write parameters for NSS on Linux. For information, see "Configuring or Tuning Group I/O" on page 396.
Dynamic Storage Technology (DST) For information about NSS volume attributes and features that are supported in DST shadow volumes, see "Using NSS Volumes in DST Shadow Volume Pairs" in the *OES 2018 SP3: Dynamic Storage Technology Administration Guide*.	DST supports NSS volumes on OES 2015 or later servers as the primary or secondary volume in the shadow volume. For information, see the *OES 2018 SP3: Dynamic Storage Technology Administration Guide*.

E Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems

This section compares features and capabilities of the OES Storage Services file system on Open Enterprise Server to those of NCP volumes on Linux POSIX file systems such as Ext3, XFS, BtrFS, and Reiser. For information, see "Managing NCP Volumes" in the *OES 2018 SP3: NCP Server for Linux Administration Guide*.

For information to help you choose from among the numerous Linux file system offerings, see "Overview of Linux POSIX File Systems" in the *OES 2015 SP1: Linux POSIX Volume Administration Guide*.

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
Management interfaces	iManager Storage plug-in. For information, see Section 10.1, "iManager and Storage-Related Plug-Ins," on page 93. NSSMU for Linux NLVM NSS utilities in a terminal console NSS commands in the NSS Console (NSSCON) OES Remote Manager for Linux (browse only)	YaST > Partitioner for managing devices OES Remote Manager for Linux (Managing Shares) NCP commands in the NCP Console (NCPCON) Various Linux commands and utilities in a terminal console. NSSMU NLVM commands
File system trustees and trustee rights to control access to directories and files	Yes, works with or without concurrent running of NCP Server.	Yes, requires NCP Server to enforce the rights and access on the extended attributes.
File access protocols	NCP Linux NFS (version 3) Linux NFS requires users to be Linux-enabled with Linux User Management. The service must also be LUM enabled. OES AFP for Linux OES CIFS for Linux	NCP NCP Volumes requires users to be Linux-enabled with Linux User Management. The service must also be LUM enabled.

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
File system directory and file attributes to control functions available for directories and files	Files and Folders plug-in to iManager OES NetStorage Client for Open Enterprise Server OES Remote Manager for Linux. See "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *OES 2018: File Systems Management Guide*.	Not applicable. Use POSIX file and directory attributes.
Directory quotas	Yes, requires the Directory Quotas attribute to be enabled.	Yes
User space quotas (user space restrictions)	Yes, for OES Linux SP2 and later	Yes, if the Linux file system being used under the NCP share supports user quotas and the Linux file system resides on a local, iSCSI, or Fibre Channel drive. All users of the NCP volume must be LUM enabled. Manage the user quotas using the Linux file system tools.
Default mount location for NSS pools	`/opt/novell/nss/mnt/.pools/poolname`	Not applicable.
Volume name space	Long is the default name space, which is case insensitive. You can specify the UNIX name spaces on mounting the NSS volume to make its directory names and filenames case sensitive. Using UNIX name space slows performance compared to using Long. For example: `ncpcon mount /opt=ns=<long|unix|dos|mac> <volume_name>` The name space options are case sensitive.	UNIX; no support for case insensitive names.
Salvage for deleted volumes, directories, and files	Yes	No
Volume encryption	Yes, for OES SP2 and later	Yes, for Reiser
File compression	Yes	No

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
Data shredding (secure deletion)	Yes, up to 7 times	No
Online resizing of volumes and pools	Yes	Yes, depending on the file system
Multiple I/O paths to storage media For information, see Managing Multipath I/O for Devices (https://www.suse.com/documentation/sles-12/stor_admin/data/cha_multipath.html) in the SLES 12: Storage Administration Guide (https://www.suse.com/documentation/sles-12/stor_admin/data/stor_admin.html).	No; NSS-specific multipath I/O tools as are not available on Linux. Use the Linux Device Mapper driver support for mutlipath I/O on devices where you plan to create NSS file systems.	Use the Linux Device Mapper driver support for mutlipath I/O on devices. (NCP is not required to make this work.)
Software RAID support	RAID 0, 1, 5, 0+1, and 5+1.	RAID 0, 1, 4, 5 and 6. RAID 0+1 can be created using the Linux `mdadm(8)` command as a complex RAID using the RAID 0+1 option, or as a nested RAID.
Pool snapshot (retain point-in-time version of a pool using block-level copy on write)	Yes, using iManager, NSSMU, or NLVM command line interface. Snapshots of cluster-enabled pools is not supported.	Depends on the file system. NLVM supports device snapshots for the devices it manages. (NCP is not required to make this work.)
Hard links	Yes; enhanced hard links support is available in OES 2 and later. For information, see Chapter 25, “Managing Hard Links,” on page 363.	Yes
Backup support	Yes, using OES Storage Management Services for Linux. For information, see Chapter 27, “Managing Backup and Restore for Data and Trustee Information,” on page 389.	Yes. You can use SMS. For more information, see POSIX File System Support.
Data migration from NSS volumes on NetWare	Yes	Yes
OES Archive and Version Services	No	No

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
OES Distributed File Services For information, see the *OES 2018 SP3: Distributed File Services Administration Guide for Linux*.	Yes, for OES 2 and later. NSS volumes on OES 2015 can contain junctions or be a junction target. NSS volumes on OES 1 can be a junction target, but junctions are not supported in the volume.	Only as targets of junctions in OES 2 and later. DFS does not support junctions on NCP volumes.
Dynamic Storage Technology For information, see the *OES 2018 SP3: Dynamic Storage Technology Administration Guide*.	Yes	Not available.
OES Cluster Services for Linux For information, see the *OES 2018 SP3: OES Cluster Services for Linux Administration Guide*.	Yes For information, see "Creating Cluster-Enabled Pools and Volumes".	Yes; cluster the Linux POSIX file system, then create the NCP volume on it. For information, see "Upgrading and Managing Cluster Resources for Linux POSIX Volumes with CSM Containers". You can NCP enable the clustered Linux volume as you create it by using NSSMU or the 'nlvm create linux volume' command. For information, see "Clustering LVM Volume Groups with Novell Cluster Services" in the *OES 2015 SP1: Linux POSIX Volume Administration Guide*. "Creating a Linux Volume on a Device that Contains a Novell Partition" in the *OES 2018 SP3: NLVM Reference*.
Auditing	Yes	No
Transaction Tracking System (TTS)	No	Use the Journal mode for Linux POSIX file systems that support journaling.
Operating system version detection	Default process	Default process
Device maintenance support	Activate and deactivate devices by pool.	Activate and deactivate devices using Linux tools.

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
Cache balancing for NSS cache buffers	You can specify a minimum cache buffer size. For information, see "Tuning NSS Performance" on page 395.	Integrated with the Linux file system cache.
CD and DVD device recognition	No; not managed by NSS. Use Linux services to mount CDs and DVDs as Linux volumes.	Yes, default
Ability to access DOS partitions as on a NetWare server	No; not managed by NSS. Use Linux services instead.	Yes, using Linux services.
Default mount location for NSS volumes	`/media/nss/volumename`	Not applicable.
Interface	64-bit	64-bit
Character format	Unicode	UTF-8
Maximum device size recognized (physical or logical)	8 TB for NSS32 pools and 8 EB for NSS64 pools. NSS management tools recognize devices up to 8 EB, and support both the GPT and DOS partitioning schemes. For use in an NSS pool, the maximum device sizes supported are: 8 TB (GPT) for NSS32 Pools 8 EB (GPT) for NSS64 Pools 2 TB (DOS) for NSS32 and NSS64 pools	For a 64-bit OS: ◆ 2 to 32 TB for Ext2 or Ext3, depending on the block size ◆ 16 TB (minus 1 Byte) for Reiser ◆ 16 EB for Btrfs and XFS
Maximum software RAID size (combined total of all member segments)	8 TB (GPT) for NSS32 Pools 8 EB (GPT) for NSS64 Pools 2 TB (DOS) for NSS32 and NSS64 pools **NOTE:** The pools are currently limited to 8 TB for NSS32 and 8 EB for NSS64, RAID1 sizes for pool objects are also limited to 8 TB or 8 EB depending on the pool type.	See Maximum device size recognized.
Minimum software RAID segment size	12 MB per segment	Depends on the file system.

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
Maximum partition size	8 TB for NSS32 and 8 EB for NSS64 pools Valid Range: 12 MB to 8 TB for NSS32 pools, and 12 MB to 8 EB for NSS64 pools **NOTE:** The Maximum segment size corresponds only to GPT partition. If all devices are partitioned using DOS, the size limits to 2 TB.	Up to 16 TB or 16 EB, depending on the file system and block size as noted above.
Maximum number of partitions (logical or physical devices) per pool	No practical limit	Not applicable.
Maximum pool size	8 TB for NSS32 pools (using 4 or more partitions of up to 2 TB each and if device is partitioned with GPT which is of >=8 TB size you can have a pool of 8 TB with single partition only) 8 EB for NSS64 pools	Up to the partition size, depending on the file system.
Minimum pool size	12 MB for both NSS32 and NSS64 pools.	Not applicable.
Maximum size of a volume	Up to 8 TB or 8 EB, depending on the pool size, pool type and available space in the pool. Volume quotas can be overbooked. For information, see Section 19.2, “Guidelines for NSS Volumes,” on page 266.	Up to the partition size, depending on the file system.
Maximum file size	Up to 8 TB or 8 EB, depending on the volume size, pool type, and available space in the volume.	2 GB to 2 TB for Ext2 or Ext3, depending on the block size. Up to 8 TB for Reiser. Up to 8 EB (minus 1 Byte) for XFS Up to 8 EB for Btrfs (due to Linux kernel limit)

Feature Description	NSS on OES 2018 SP2	NCP Volumes on Linux POSIX File Systems
Maximum number of files per volume (In practice, how many files be managed is limited only by the file browser's and application's ability to list and access the files.)	Up to 8 trillion (10E12), regardless of how many name spaces are loaded. Up to 4 billion (10E9) files in a single directory.	Up to 8 trillion (10E12), regardless of how many name spaces are loaded.
Maximum number of files open concurrently	No practical limit on the number of files open concurrently. If any number is limited, it might be because of the system, file access protocols or any similar configuration. Other factors such as system resources can also influence this number.	Millions (10E6), depending on the file system
Maximum number of volumes per server	Unlimited NSS data volumes, but only 255 can be mounted at a time	Unlimited
Time to mount a volume	Requires only a few seconds NSS uses a journaling file system and does not need to scan the entire file system to create a directory entry table (DET) and to load a File Allocation Table (FAT).	Depends on the file system; from a few seconds to a few minutes.
Time to repair corrupted volume	Up to several hours, depending on the volume size.	Up to several hours, depending on the volume size

F NSS Nomenclature

This section describes the nomenclature used for key OES Storage Services media objects in Open Enterprise Server. This information can help you better understand the nature of error messages you might receive when using NSS. The table identifies the media object, defines it, and indicates the version of NetWare or OES where the media object first appeared.

NOTE: All ZLSS (NSS Journaled Storage System) file blocks are 4 KB in size.

Media Object	Definition	Version Where First Used
Area Seed	To improve performance for OES 2015, metadata blocks use an area seed logic to make sure that related metadata blocks are physically stored near each other. For information about configuring area size, see Section 28.3.1, "Viewing the Metadata Area Size," on page 397.	OES 2 Linux (not available on NetWare)
Beast B-Tree	The Balanced Tree (B-Tree) that tracks all the file's metadata. This includes when the file was created, who created the file, the size of the file, and the location of the file's data.	NetWare 5.0
Checkpoint	Four blocks (one in each Superblock) that track where to start playing the journal if the server crashes. The checkpoint contains the metadata of the Journal.	NetWare 5.0
Directory B-Tree	Used to implement an NSS volume's Directory Quota feature.	NetWare 5.0 Support Packs
Epoch File Log (EFL) B-Tree	Tracks files that change during an administrator-specified interval of time called an epoch. This feature is used by OES Archive and Version Services.	NetWare 6.5
Globally Unique ID (GUID)	A globally unique identifier within eDirectory. The scope of this uniqueness is within one tree, although no actual checking is done to ensure this. GUIDs are 128 bits and are unique for each object. GUIDs allow an object to be referenced no matter which server you are accessing.	NetWare 5.0
Journal	The file used to quickly make the file system consistent after a server crash. The journal is sometimes referred to as a zlog.	NetWare 5.0
Logged Pool Data Block	The block that tracks information about the pool, including the number of used blocks and salvageable blocks. Holds some of the items found in the zPoolInfo_s portion of the zInfo_s structure.	NetWare 6.0

Media Object	Definition	Version Where First Used
Logged Volume Data Block	The block that tracks the number of files, used blocks, and compressed files of a volume. Holds some of the items found in the zVolumeInfo_s portion of the zInfo_s structure.	NetWare 5.0
Modified File List (MFL) B-Tree	Tracks files and folders that have the Archive attribute set by the user. The Archive flag indicates that the file or folder needs to be backed up. NSS uses this list to quickly find files that need to be backed up during scheduled backups. This Archive file-and-folder attribute is unrelated to OES Archive and Version Services.	NetWare 6.0
Multiple Server Activation Protection (MSAP)	The block used to reduce accidental use of a pool by more than one server at a time. A single copy of this block is stored in the second Superblock.	NetWare 6.0 Support Packs
Name Tree B-Tree	The B-Tree that tracks the directory structure of a volume.	NetWare 5.0
Pool Data Block	The block that tracks persistent pool configurable items. For example, a pool's features are stored here. Holds some of the items found in zPoolInfo_s portion of the zInfo_s structure.	NetWare 6.0
Purge Log	Tracks transactions over an extended period so they can be completed after a crash. For example, the log records file deletes and truncates that need to be completed after a crash.	NetWare 5.0
Purge Tree B-Tree	Used to store information about all salvageable files. This tree is used when the file system needs to autopurge files to create free blocks.	NetWare 5.0
Snapshot	Used by the Media Manager to track pool snapshots. The object tracks which snapshots exist on a pool and where all blocks of a snapshot are stored. The root of this object resides in the first Superblock. All other blocks are allocated from a file on the internal volume.	NetWare 6.5
Superblock	There are four Superblocks of 16 blocks each. The four Superblocks are replicas that reside in four fixed locations within the pool. The Superblock is used by the Checkpoints, Superblock Header, Snapshot, and Multiple Server Access Prevention.	NetWare 5.0
Superblock Header	Four blocks (copies of each other, one in each Superblock) used to locate all other ZLSS media objects. These are the first blocks that the file system reads when a volume is loaded. Starting with NetWare 6.0, these blocks are read when a pool is loaded.	NetWare 5.0
User B-Tree	Used to implement an NSS volume's User Quota feature. Starting with NetWare 6.0, the B-Tree also stores NetIQ eDirectory information related to User Quota.	NetWare 5.0 Support Packs
Volume Data Block	The block that tracks configurable items in NSS volumes such as the volume's attributes and the high and low watermarks for salvage. It holds some of the items found in zVolumeInfo_s portion of the zInfo_s structure.	NetWare 5.0

Media Object	Definition	Version Where First Used
ZID	A numeric ID within the NSS file system, used to reference an object with the object store (also known as the “beast tree”). ZIDs are 64 bits and are unique for each volume.	NetWare 6.0